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# ROENTGENOLOGICAL AID IN THE DIAGNOSIS OF ILEUS*

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WE wish to state very emphatically at the outset that there is no intention whatever in this paper to discount the classical signs of acute intestinal obstruction, but rather again to call attention to an additional sign. There are few incidents in the postoperative course of a surgical case more distressing than the calamity of acute intestinal obstruction. As one writer has put it, after a patient has undergone the mental and physical strain attendant upon a severe surgical operation, and has just begun to feel the satisfaction and physical benefit consequent upon having passed safely through such an ordeal, to be called upon again to submit to further and greater surgical hazard is to stretch almost to the breaking point the fortitude and the physical endurance of the hardiest. Thanks to great improvements in surgical technique during the last ten or fifteen years, especially the abandonment of cathartics as a means of preoperative preparation, we see fewer cases, but as long as surgeons have to deal with purulent processes in the abdomen and pelvis, the occurrence of an occasional case of ileus will be inevitable.

It is indeed a tragedy when a patient, who on reviving from his anesthetic sleep is assured that all is well, has to be prepared again for operation. The onset of sudden pains, with nausea and perhaps vomiting, abdominal distention, colicky cramps, and the attendant anxiety, bring up the question of acute obstruction. None more reluctant than the surgeon, none more unwilling than the friends in their ignorance of surgical problems, to propose to the patient another operative séance. It is so easy for delays to creep in, and it is these very delays which cost many patients their lives. Hence, we should welcome any means of more surely determining the fact of obstruction.

The surgeon who opens the abdomen of a patient believed to be suffering from acute intestinal obstruction expects to find dilated coils of bowel, usually small bowel, containing much gas and fluid. The gravity of the patient's situation is judged to a considerable degree by the diameter of the dilated intestinal coils and their integrity. The operator may content himself with doing a simple ileostomy on the nearest dilated loop as a life-saving procedure without pursuing the examination to the point of finding out the precise cause of the obstruction. The discovery of dilated small bowel is the goal sought; in the absence of dilated intestinal loops, the surgeon will feel that

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the preoperative diagnosis of acute ileus is incorrect.

Here we have a basis for roentgenological aid in the diagnosis of acute intestinal obstruction, especially postoperative ileus. Before deciding to operate, it is necessary to establish the fact of obstruction. In the opened abdomen the fact is proved by finding widely dilated coils of bowel. It is quite possible to learn of the presence or absence of small intestinal dilatation without opening the abdomen if we use the roentgenological means available today in almost every hospital, no matter how small.

The instruments required are simple: a portable roentgen-ray apparatus suitable for bedside work; a film-holding cassette equipped with double screens; and facilities for film development. No preparation of the patient is required, not even rearrangement of the bandages or dressings. Usually no opaque meal is desirable.

The interpretation depends upon the study of the gas areas within the abdominal shadow. Gas is very easily recognized, as easily almost as a candle in a darkened room; and by the study of abdominal gas collections as to form, location, contours, etc., one may decide whether the small bowel is dilated to a degree sufficient to warrant a diagnosis of acute obstruction. Even in chronic obstructions of the small intestine much information may be derived from a study of gas areas. It is well known to what extent colonic gas accumulates in the ordinary case of constipation.

## REVIEW OF PREVIOUS WORK

Our first exhibits of roentgenograms illustrating the value of bedside roentgen-ray studies in cases of suspected acute postoperative ileus were offered in the scientific exhibits of the American Medical Association and of the American Roentgen Ray Society in 1911, and in various subsequent meetings of the same societies; and our first publication on the subject occurred in 1914 in book form.[1] Our first paper was read before the American Medical Association in 1915[2] with subsequent publications[3,4,5] following later on about the same topic. Numerous letters have been received detailing instances in which the employment of this method has resulted in the saving of life, but too frequently operations for acute intestinal obstruction are delayed until the patients have lost what remaining chance they have for life; yet the additional evidence afforded by roentgen-ray study would probably have resulted in earlier operation. We therefore feel impelled again to call attention to the value of this simple and harmless but extremely helpful method of bedside study.

On the recognition of chronic ileus by the study of abdominal gas collections, several articles have been published, commencing with those of G. Schwarz who in 1911[6] and in 1912[7] wrote several papers on this topic. He gave the following as characteristic signs of chronic ileus: (1) delayed emptying of the small intestine; (2) dilatation of the small intestine, often permitting recognition of the valves of Kerkring, and (3) quantities of gas and fluid in the small intestine. Schwarz studied his patients in the erect position. Stierlin,[8] who in 1913 wrote on the roentgen diagnosis of stenosis of the small intestine, examined his patients in the horizontal position. He gave no barium by mouth, but administered an opaque enema when it offered a chance to help in the identification of gas collections. In other words, Stierlin made the diagnosis of chronic obstruction without the barium meal, by recognizing collections of gas in the small intestine. Kloiber[9,10] thought he could make the diagnosis without the use of any opaque material either by mouth or by clysma, if he could discover gas pockets over fluid levels. He thought that to do this properly he must have the patient erect, although, as the writer has shown, it is quite possible to reach conclusions of considerable value with the patient lying on one side, passing the roentgen rays through the patient in a horizontal direction. Weil[11] has described the same appearance in a patient with chronic ileus from a carcinoma of the splenic flexure of the colon.

Kloiber used the roentgen-ray method also in cases of acute small intestinal obstruction, employing essentially the same technique published by ourselves

Fig. 1. Typical gas appearance in chronic aerophagy showing characteristic outlines of gas accumulations in the stomach, in the small bowel and in the colon, in the absence of any clinical evidence of obstruction.

Fig. 2. Roentgenogram after opaque filling of the colon through a small tube passed through a cecostomy opening. The gas in the stomach shows plainly. The colon is in part outlined by opaque material and in part by gas. Note the characteristic reticulated appearance of the small intestinal shadow in a case of ordinary chronic intestinal stasis.

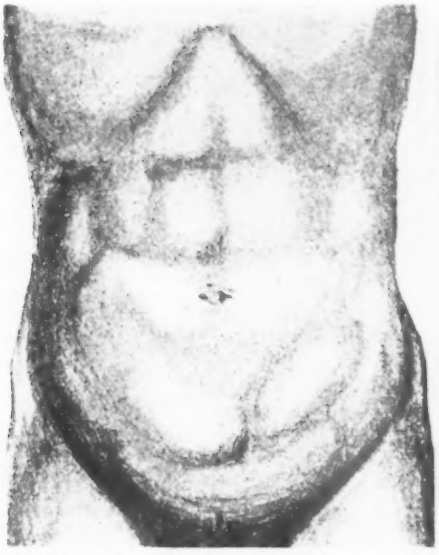

Fig. 3. Illustration (after Treves) showing external appearance of abdomen with general gas accumulations in both large and small bowel.

Fig. 4. Illustration (after Treves) showing external appearance of typical ladder arrangement in case of acute small intestinal obstruction.

FIG. 5. Acute small intestinal obstruction, upper abdomen, attending gangrene of cecum in case of carcinoma of sigmoid: (S) Gas-filled stomach. Arrows indicate uppermost loop of dilated small intestine.

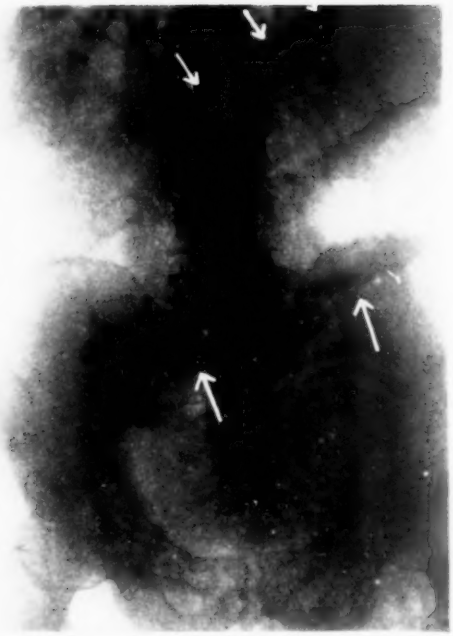

FIG. 6. Case of acute obstruction supervening in a chronic ileus of small bowel due to primary malignant growth (adenocarcinoma about 3 feet above ileocecal valve). Preoperative study. (See Fig. 7.)

in 1915, but apparently laying much more stress on the erect position. He evidently employs plenty of help to maintain the patient in the erect position long enough to make the examination.

Guillaume[12] in 1922, published a book on acute and subacute obstructions of the intestine, in which he describes the method employed by us, and reproduces some of our illustrations.

In the United States the employment of this method has extended. Recently Meyer and Brams[13] have reported definite help from the roentgenologic study of acute intestinal obstruction.

## TECHNIQUE

The patient is carefully lifted on his draw-sheet while a cassette is placed beneath him. He is not turned onto the face, but left as much undisturbed as possible. A portable bedside instrument is rolled to the proper position, the tube adjusted over the patient's abdomen, and, in a second of suspended respiration, the exposure is made. The cassette is withdrawn and the patient left without having been subjected to more disturbance than

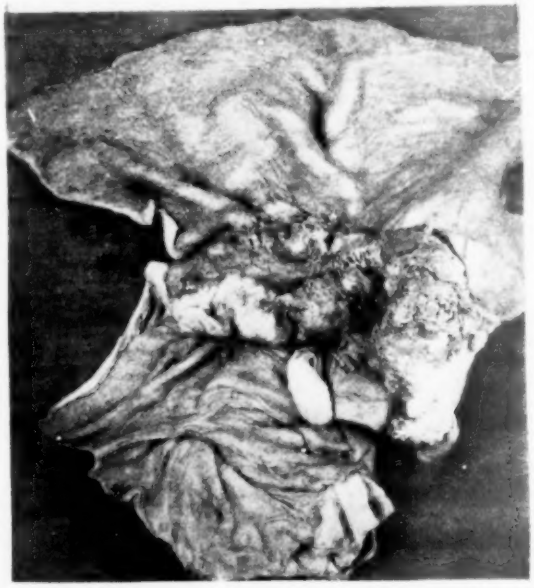

FIG. 7. Photograph of primary carcinoma of small intestine of case illustrated in Figure 6.

attends a catheterization—not half the disturbance incident to a change of bed linen. In ten or fifteen minutes the film may be interpreted, and the question of

FIG. 8. (See Fig. 9.) The fact of intestinal obstruction is definitely shown in this case without any barium. Yet, because of the indecision regarding the need of operation, barium was administered and another examination made twelve hours later.

FIG. 9. (See Fig. 8.) Barium now visualizes the distended small intestines. The operation which was then done had been unnecessarily delayed twelve hours.

FIG. 10. Stepladder appearance due to parallel dilated coils of small bowel. Acute intestinal obstruction postoperative. Ileostomy. Cure.

FIG. 11. Cholecystectomy for gallstones; appendectomy; relief of Lane's kink of terminal ileum. This film made forty-eight hours later shows acute small intestinal obstruction due to adhesions at site of operation on Lane's kink. Recovery after ileostomy.

FIG. 12. (See Fig. 13.) Small child operated on in 1925 for appendix disease. Interval operation. June, 1926, sudden acute attack of abdominal distress which proved at operation to be a volvulus with gangrene necessitating removal of several feet of small bowel. Because of peculiar distressing circumstances of the case, operation not done for twenty-four hours after onset permitting several films to be exposed. This film shows some material in the colon administered by enema but very definitely the loops of distended small bowel above the volvulus shown at arrows.

FIG. 13. (See Fig. 12.) Film taken in right lateral horizontal position showing numerous levels of fluid surmounted by gas, some marked by arrows. Case of acute small intestinal obstruction due to volvulus. Operation. Cure.

obstruction settled. No opaque material has been given to the patient, although, if there are necessary delays in arriving at a decision, it is our experience that no harm results from the administration of from 10 to 20 gm. of barium sulphate in a water and lactose mixture. A very little will suffice. It may be given even in the presence of fecal vomiting, if delays have occurred. Subsequent films may be exposed at intervals of a few hours until a decision has been reached.

As just stated, in the average case the patient is left flat on his back and the film is placed beneath him, the rays passing in the anteroposterior direction. To study fluid levels, it would be natural to place the patient in the erect position; but in the majority of instances the emergency arises a few hours after an abdominal operation and it is possible only to turn the sick one upon his side, right or left according to the circumstances, and make an anterior or posterior roentgenogram in this lateral position, with the rays passing parallel with the floor. If a question of subphrenic abscess has arisen, the right side should usually be uppermost; whether the film should be placed anteriorly or posteriorly is a matter to be disposed of to suit convenience. It is highly important that the film be exposed during suspended respiration.

## INTERPRETATION

Normally there is no gas in the small intestine, at least not in quantity sufficient to be recognized on the roentgenogram. In aerophagia and in certain states of chronic small intestinal stasis not due to any organic obstruction, gas found in the small bowel presents a characteristic appearance: numerous small, irregularly-spaced gas areas, giving to the central portion of the abdominal shadow the reticulated or web-like aspect shown in Figures 1 and 2, which is in distinct contrast to the gastric and colonic gas collections shown in the same illustrations. The gastric gas areas occupy a position close up under the left diaphragm and above the transverse colon. The colonic gas collections show very distinct haustral markings which usually occupy the periphery of the abdominal area and are in the great majority of cases easily identified (Figs. 1, 2 and 3). It is apparent that any

FIG. 14. Film taken in erect position showing ileus due to perforation of gastric ulcer. Also subhepatic abscess. Note fluid level in abscess (a); also in numerous coils of intestine. Some barium in stomach.

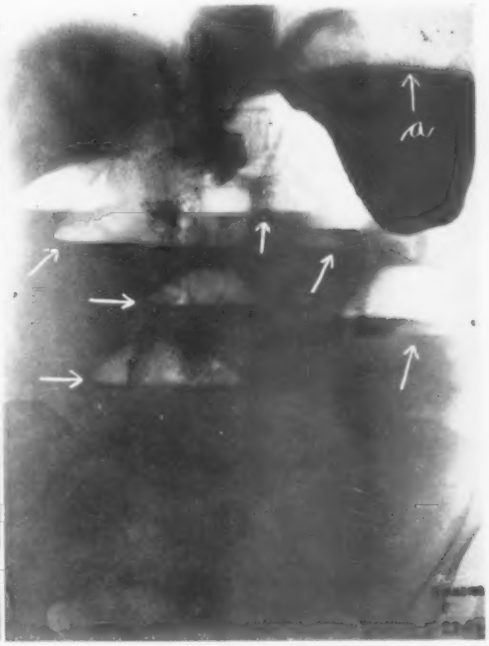


FIG. 15. Acute small intestinal obstruction film made with patient in erect position. Note fluid level (a) in stomach. Other fluid levels in colon and small intestine.

FIG. 16. Film made on routine examination third morning after partial gastric resection for carcinoma, Pólya method. Very marked distention of proximal colon. Some gas in left half of colon. None in small bowel. Patient's abdominal distress relieved by soap and glycerine enemas.

FIG. 17. Film exposed thirty-six hours after laparotomy for resection of part of sigmoid. The marked abdominal distention suggested possible acute obstruction. Roentgen-ray evidence indicates gas collections in large bowel. None in small bowel. Relief after soap and glycerine enemas.

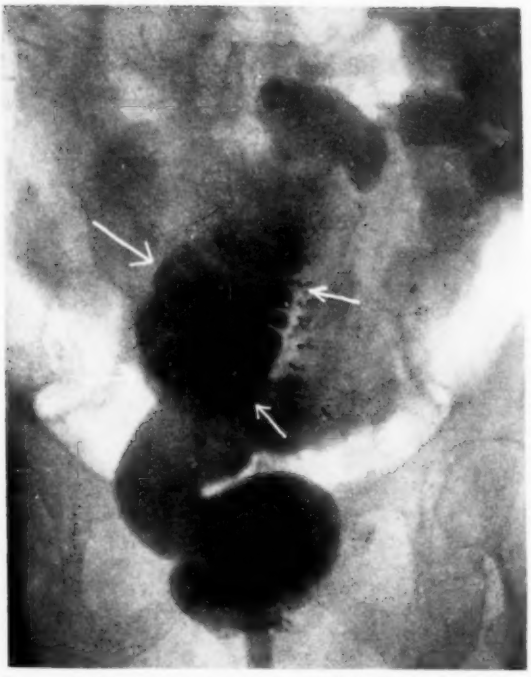

Fig. 18. Symptoms of acute small intestinal obstruction occurring third day after pelvic laparotomy. Roentgen-ray examination showed barium collection indicated at arrows. Not clear at that time whether collection occurred in sigmoid or in ileum. Therefore small opaque enema was given which showed shadow under question to be unquestionably obstruction of small bowel. Ileostomy. Recovery.

gas collection not clearly gastric or colonic is in all probability imprisoned in the small bowel.

In acute small bowel obstruction, the appearance of the jejuno-ileal loops is very striking. Two types of bowel outline may be described: (1) a "herring-bone appearance" due to the gas causing the folds of Kerkring to stand out by contrast, giving a feathery or slashed appearance to the intestinal loop (Figs. 5, 6, 7, 8 and 9); and (2) a "ladder arrangement" of the shadows of the bowel coils (Figs. 4, 5, 10, 11 and 12), when the distended loops lie parallel. The latter appearance is pathognomonic of acute obstruction requiring immediate surgery. The herring-bone aspect signifies a degree of hindrance which constitutes a serious menace to the patient but which has in some instances been seen to appear and later disappear under non-surgical treatment.

It is important to estimate the diameter of the intestine when the herring-bone aspect is noted. Considering that our films are placed as close as possible to the patient's body, it is possible, with a reasonable discount for distortion, to estimate the diameter of the intestinal coils. The presence of intestinal coils of a certain considerable diameter spells obstruction and indicates the need of prompt surgical relief. Even a single such loop of only a few centimeters' length is sufficient to warrant the diagnosis of ileus requiring operation.

Gas and fluid commence to accumulate in discernible quantity within six or eight hours after the establishment of obstruction. In several cases, by making a lateral film, we were able to recognize the presence of gas over a fluid level in small bowel loops (Figs. 13, 14 and 15). Here one must differentiate between gas in the colon and gas in the small bowel. A few fluid levels high up in the abdomen suggest high ileus; many levels, low in the abdomen, or even in the true pelvis, indicate a low ileus. This is more easily determined in the erect than in the lateral position but the latter is the only one usually feasible.

In general, and considering both the anteroposterior and the lateral roentgenograms, small intestinal obstruction is indicated by irregular gas areas, mostly in the center of the abdomen; gas collections over fluid levels more broad than high; diaphragm usually not elevated; bowel wall often not seen, but when visible shows Kerkring's folds (herring-bone aspect); when the ladder effect is seen, the space between parallel bowel loops is so narrow that the bowel wall is seen to be very thin, and the borderline regular.

In the majority of cases of acute ileus the obstruction is jejuno-ileal or at the ileocecal junction, not in the colon; hence, identification of the gas as lying in the colon practically eliminates the question of acute small intestinal obstruction.

Colonic gas (Figs. 16 and 17) generally occupies the periphery of the abdomen, mostly in the cecum, the sigmoid and the flexures; the diaphragm is usually high; the bowel wall is always seen, with irregular borderline characteristic of the haustra coli; and when contiguous loops are seen, the bowel wall is noted to be thick. In the erect

FIG. 19. (See Fig. 20.) Acute small intestinal obstruction occurring eleven days after ileosigmoidostomy. Professional friends could not be convinced without absolute proof so barium-water-glucose mixture was given by mouth to demonstrate small bowel. Procedure now seldom required. The gas appearances are usually sufficient to permit an opinion.

FIG. 20. Same case shown in Figure 19, six hours after administration of barium-water-glucose mixture by mouth. Note characteristic outline of jejunum. High obstruction.

position the gas pockets over fluid levels are seen to be high and narrow rather than broad; in the lateral position broad fluid levels suggest colon or stomach. It is not always possible to differentiate colonic loops from distended small bowel.

In those cases where it seems desirable to supplement the study of gas areas by opaque material, we have seen no harm from the administration of a little barium in a lactose-water medium, or by enema (Figs. 8, 9 and 18). When the latter is employed, a suspension of barium in mineral oil seems most inoffensive. So far as we know, the only contraindication to the use of barium is an enteroanastomosis low in the ileum or in the colon. Even in high intestinal or gastrointestinal anastomoses we have seen no harm from a small quantity of barium.

When in doubt as to the identity of a certain gas area, it is a simple matter to give an opaque enema to exclude the colon (Fig. 18). A gastric gas accumulation is easily recognized (Figs. 1, 2, 5, 13, 14 and 15), and any remaining pocket of air or gas must lie in the small bowel. We find that in practice the enema is seldom required.

The interpretation of the bowel when visualized by barium is usually easy. The aspect of *widely dilated* loops of intestine, showing Kerkring's folds, is a signal for immediate surgical intervention (Figs. 19, 20, 21 and 22). When such herring-bone loops do not show much dilatation, the need is for careful watch while waiting, meanwhile redoubling one's efforts by various means to promote bowel movement. Another film should be exposed within a few hours for check on progress.

In the early days of our interest in this problem, we made a routine study of all abdominal cases for the three days immediately following operation, some with the aid of the barium, and many without. We are impressed that many patients, passing through what is apparently an uneventful convalescence, really suffer a certain grade of ileus, the existence of which would not be suspected except after the roentgen study. This transient mild ileus passes in the course of the usual postoperative treatment. In some other

Fig. 21. Malignant obstruction in sigmoid. Inoperable. Left inguinal colostomy. Postoperative ileus due to incarceration of knuckle of small bowel alongside colon at site of colostomy. Film shows duodenal tube in stomach through which a barium-water-glucose mixture was administered, visualizing small intestine, terminating at site of colostomy, indicated by rubber tube in place. Operation to relieve knuckling. Temporary recovery. Final death from carcinoma.

Fig. 22. Multiple tuberculous obstructions in small intestine and in descending colon. Small bowel obstruction (A) in acute stage.

cases, there is a more severe grade of ileus, explained in various other ways by the surgeon who does not utilize the aid of the roentgen rays; and in a few cases (very few in these days of advanced surgical technique) a really serious obstruction which claims attention and is recognized as such. It is not surprising that a relative obstruction due to paresis should follow many abdominal operations. The mere opening of the abdomen and a minimum amount of traumatism even with very gentle handling of intestine cause a definite reaction in the form of inhibition of peristalsis. This would be classed as a certain grade of paralytic ileus; but is it not reasonable to believe that such a condition occurring immediately postoperative, tends to encourage the formation of the adhesions which may later mark the case as one of mechanical obstruction? And after all, any case of mechanical ileus left uncared for sooner or later manifests complete paralysis of the bowel.

The question naturally presents itself as to our ability to differentiate paralytic from mechanical ileus by the roentgen method. We have not found any criteria, purely roentgenologic, which permit this differentiation. The roentgen films afford evidence of the fact of ileus. They show the presence of fluid and gas in abnormal situations, the unusually wide diameter of coils of bowel, and the identity of the dilated coils, whether colonic or jejuno-ileal; and they afford an approximation as to the site of obstruction—whether high or low. This is important aid and may be supplemented by more exact data if one waits for the transit of opaque material given by mouth, or the opaque enema.

It is our custom to do an ileostomy over the lowest distended coil of small bowel: this serves as a life-saver whether the obstruction be jejuno-ileal or colonic, mechanical or paralytic. When the patient has been tided over the acute situation, radical attention to the hindrance, if it still exists, may be undertaken. We may state that in our own experience a secondary operation is usually not required.

Sometimes we see cases of intestinal obstruction which are not postoperative where the usual signs of tympany are not

Fig. 23. Volvulus low in ileum. The mass of twisted bowel forms a tumor which displaces the colon and cecum as shown at arrows. Operation. Recovery.

Fig. 24. Acute duodenal ileus following operation for partial resection of stomach (Pólya method). In some manner there occurred kinking of jejunum below anastomosis with resulting accumulation in the duodenum of the opaque material given by mouth.

clear. Figure 23 illustrates such a case. This patient was brought into the hospital apparently suffering from acute intestinal obstruction. A large mass was easily felt in the lower abdomen, more on the right than on the left side. On bimanual examination an indefinite, fairly firmly fixed but slightly yielding mass was palpated. A pelvic tumor, probably ovarian, with twisted pedicle was suggested as the diagnosis. A barium enema was administered to exclude a lesion of the colon. In Figure 23 we see the result of the barium enema. The appearance is exactly similar to that caused by a large pelvic tumor (uterine fibroid or ovarian cyst), displacing the colon in various directions. At operation there was found no abnormality in the pelvic organs or in the colon; the displacement was due to a volvulus of small intestine, the group of obstructed coils corresponding to the mass which previously had been felt on bimanual study.

Another very interesting use of the roentgen ray for the diagnosis of acute postoperative obstruction relates to acute duodenal ileus. Figure 24 illustrates such a case. Following operation for partial resection of the stomach by the Pólya method, in some way there occurred a kinking of the duodenum below the anastomosis with resultant accumulation in the duodenum of the small amount of opaque material which was given by mouth.

## SUMMARY

1. This paper makes no attempt to discount any of the usual clinical signs of acute obstruction of the intestine. It emphasizes once more an additional sign, available through bedside roentgen-ray study, first published by us in 1914.

2. This roentgen-ray study at the bedside disturbs this patient very little, if any at all. No dressings are removed. The patient is not turned on the face, but is left supine.

3. Usually no opaque medium is given, though it may be used with profit and without harm in most instances (barium-water-lactose mixture). An opaque enema (barium-oil) is sometimes helpful.

4. A diagnosis of acute obstruction is

based on the finding of dilated coils of small intestine (herring-bone aspect, ladder arrangement), visualized by gas, or gas and fluid, accumulations.

5. The method is valuable in both acute and chronic ileus. In the latter, the patient is better examined in the erect position; the diagnosis is based on broad (not high) gas pockets over fluid levels in abnormal situations. In acute cases, the erect position is usually not feasible, and studies are made in lateral and supine positions where the diagnosis depends on recognition of Kerkring's folds in dilated, parallel loops of intestine.

6. The method is of special value immediately after operation in abdominal cases.

7. The chief value lies in the ability to determine by roentgen rays the existence of dilated loops of bowel; to differentiate gas in small bowel from colonic gas; to estimate the actual caliber of the intestinal loops thus visualized; to estimate the approximate site of the obstruction, but mainly to confirm the fact of ileus before proceeding to the emergency operation. In the absence of dilated intestinal loops, one doubts the fact of ileus.

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## ABSTRACT OF DISCUSSION

Dr. C. B. Keenan, Montreal, spoke of the difficulties of diagnosing acute obstruction of the small intestine before the use of the roentgen ray. He stated that he had been using the roentgen ray in collaboration with Dr. Pirie for the diagnosing of this condition for about six years and that they depend upon what Dr. Pirie had described as the ladder pattern. He stated that when this ladder-like appearance of the small intestinal coils is present a diagnosis of small intestinal obstruction can be confidently made.

Dr. John T. Murphy, Toledo, Ohio, stated his belief that there is danger in administering barium mixtures to postoperative patients because in these patients the body is very low in liquids; administration of barium either by mouth or by rectum in watery suspensions results in rapid absorption of the water and leaves the surgeon a dangerous problem to contend with because of the presence of solid masses of barium in the bowel. This danger may be avoided by using oil suspensions for barium enemas.

Dr. William H. Stewart, New York City, asked if there was any means by which the location of the small intestinal obstruction could be determined.

Dr. L. R. Sante, St. Louis, cited two cases in which there were diagnoses, confirmed by the roentgen ray, of acute small intestinal obstruction but in which the patients had recovered without operation. He asked if there is any means by which paralytic ileus may be differentiated from organic obstruction.

Dr. Case (closing). In reply to Dr. Murphy's objection to the use of barium, Dr. Case stated that he had administered barium to about 300 patients recovering from laparotomies, without the slightest inconvenience or bad results. He believes that the barium study, after its administration in the lactose-water mixture, is of great help, especially to convince the patient or physicians of the necessity for operation. In chronic ileus or in the acute attacks of chronic ileus, the presence of fluid levels is of great value for diagnosis. Dr. Case knew of no means by which paralytic ileus may be differentiated from mechanical ileus except that in the

mechanical variety there is likely to be more severe colicky pain. The incidence of this condition is now much less than formerly because of great improvement in surgical technique, and especially because of the avoidance of preoperative purgation.

# ROENTGENOLOGIC MANIFESTATIONS IN EIGHTY-SEVEN CASES OF GASTRIC SYPHILIS*

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IT is significant that case reports of gastric syphilis have increased greatly since the roentgen ray has come into routine employment for examination of the stomach. Previously the disease had been discovered occasionally at necropsy or operation, but so rarely that it ranked among the pathologic curios. Admittedly, its incidence is not high, but it occurs frequently enough to warrant habitual consideration in gastric diagnosis, and the roentgenologist has especial opportunity for directing attention to it in cases that might otherwise pass unnoted.

In order to analyze and classify the roentgenologic manifestations of gastric syphilis, the records of the Mayo Clinic from 1913 to the present have been canvassed. The material reviewed comprised the histories of 247 patients with a gastric syndrome which might be attributed to syphilis of the stomach. After all cases open to reasonable doubt had been excluded there remained 87 in which the evidence of a syphilitic gastric lesion was convincing; these constitute the basis of this study.

In respect to morbid anatomy, three varieties of gastric syphilis are commonly mentioned, namely, gastritis, ulcer, and gummatous hyperplasia. As to syphilitic gastritis, a few clinical observers have held the opinion that in the eruptive stage of syphilis there is a similar concomitant inflammation of the gastric mucosa. Whether the opinion is well grounded or not is immaterial here, for the roentgen rays could not be expected to reveal any definite signs of the condition. Claim has been made that a considerable percentage of simple, round, gastric ulcers are essentially syphilitic, but this remains to be verified. Almost all well authenticated cases of gastric syphilis which have been reported are of the third variety: diffuse gummatous infiltration and fibrous hyperplasia with thickening and eventually, contraction of the gastric wall. Frequently the mucosa of the infiltrated wall is ulcerated, the erosions being multiple, irregularly shaped and shallow, although sometimes relatively deep.

Absolute proof of the syphilitic nature of a gastric lesion, such as the demonstration of spirochetes in the affected tissue, is seldom obtained. In many of the cases that have been reported, the patient was subjected to operation, and microscopic examination of exsected tissue revealed the histologic characteristics of gummatous infiltration. However, unless the lesion produces a high degree of obstruction, which occurs rarely, operation is not indicated, and proof of the diagnosis must rest on the clinical and roentgenologic data, laboratory tests, and the effect of antisyphilitic treatment. Among the 87 patients in this series, 17 were operated on, tissue being removed for microscopic examination in 9. In 5 cases the Wassermann test was negative, but the test was contradicted by other evidence and, the condition being considered as unquestionably syphilitic, the patients were retained in the series. All patients in the series manifested definite roentgenologic signs of a gastric lesion, all but one received antisyphilitic treatment and with

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

rare exceptions substantial improvement followed.

Sixty patients were men, and 2- were women. Predominance of the disease in the fourth and fifth decades of life, as noted by many observers, was confirmed by the fact that 41 of the patients were between thirty and forty years of age, and 26 were between forty and fifty. The youngest patient was twenty, and - patients were in the third decade. Thirteen patients were in the sixth decade. The oldest

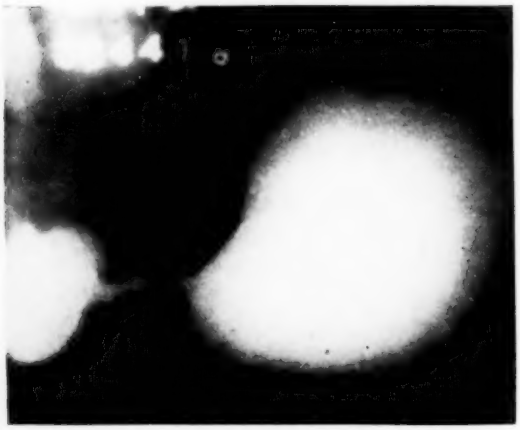

FIG. 1. Prepyloric type of gastric syphilis; concentric, cylindrical narrowing of the pyloric segment.

patient was sixty. In most patients of the series there was marked loss of weight, epigastric pain or distress, vomiting, achlorhydria, anemia without cachexia and rarely hematemesis (4 of the 8-), these symptoms constituting the syndrome so frequently described.

In the classification of the series according to the seat of involvement as indicated by the roentgenologic manifestations, three major types were distinguishable: (1) prepyloric, (2) median, or hour-glass, and (3) diffuse.

Seventy per cent of the cases were of the first (prepyloric) type. In each case the deformity produced by the lesion adjoined the pylorus, but extended proximally in varying degrees. In several cases the defect was confined to the antrum, in others it affected the entire pyloric segment, and in still others it had invaded the middle third of the stomach, but seldom did it encroach on the cardiac third. Almost without exception the defect was concentric and rather symmetric. As a rule, contraction was pronounced and the lumen narrowed progressively toward the pylorus, resulting in a spicular form of the barium shadow, although in many instances it was of tubular shape with constant diameters. Whether short or long, the contracted lumen pursued a straight or fairly direct course and was never markedly tortuous; occasionally its margins were quite smooth but more often they were slightly irregular.

Second in frequency was the median type, comprising 22 per cent of the series. In this type the pyloric and cardiac extremities of the stomach were not involved, and the lesion was confined to the segment between them, producing hour-glass deformity. As in the first type, the filling defect tended to be concentric and symmetric, and the lumen of the constricted area was relatively smooth. A notable feature in most of these cases was the great length of the constriction, so that the shadow of the deformed stomach resembled a dumb-bell rather than an hour-glass. In only a few instances could the canal be considered short, and in only one was it near the lesser curvature, producing the B-shaped deformity suggestive of gastric ulcer with hour-glass contraction.

Only 8 per cent of the cases were of the third type, with such diffuse involvement that little of the stomach remained normal. Here again concentric narrowing of the stomach with relative smoothness of the luminal outline was an outstanding characteristic. The contraction was obvious in all cases, but it varied in degree, and in one instance was so extreme that the distal three-fourths of the gastric lumen was represented by a scarcely visible thread of barium, while the cardiac segment was reduced to a small pouch. In fact, in all cases of this type the cardiac portion was more or less distensible and apparently least affected, so that the group could be regarded as an exaggerated variety of the prepyloric type.

Frequently the examiner was inclined to the diagnosis of ulcer, and in several cases mention of a niche was made in the

roentgenologic report. On a review of the films, however, it was evident that in all cases but one the niche was a localized prominence in the area of a filling defect, like the niche of an ulcerating cancer, and did not project beyond the normal limit of the gastric lumen as it does in simple ulcer. At operation in the excepted case two ulcers were found, the gastric wall being otherwise normal. In the other cases the niche was a minor feature among roentgenologic signs of extensive disease.

tively infrequent, however extensive the transverse contraction might be. Infrequency of residues from the six-hour meal was also notable, even in the face of extreme narrowing of the stomach, for retention was reported in only 6 cases. Gastric dilatation above a zone of stenosis was equally rare, with but 4 instances observed. Dilatation of the esophagus, resulting indirectly from extreme hourglass contraction of the stomach, occurred in 3 cases, but in no case apparently was

FIG. 2. Prepyloric type of gastric syphilis; conical deformity of the antrum.

FIG. 3. Same case as in Figure 2. Antral narrowing less marked after four months of antisyphilitic treatment.

As was to be expected, peristalsis was consistently lacking in the deformed portion of the stomach, and it was seldom active in the unaffected portion, even when stenosis was pronounced. Gaping of the pylorus, with a copious outflow of the barium, was common, but this is of usual occurrence in cases of achylia and in all lesions causing stiffening of the antrum. Other than these, indirect manifestations were rather conspicuously absent. In no case was fixation or lessened mobility of the stomach remarked, and perigastric adhesions or extension of the disease to adjoining organs could thus reasonably be excluded. Shortening of the stomach, although noted in a few cases, was rela-

the esophagus invaded by the syphilitic process. Most important of all was the rarity of the palpable mass. Often there was a vague sense of resistance, or the rigid gastric wall would slip from the examiner's fingers, but only once could a tumor be felt distinctly. Absence of a palpable mass, notwithstanding the presence of a gross and constant filling defect, has been emphasized more than any other sign and merits the stress it has received.

After the institution of antisyphilitic treatment 50 patients of the series were reëxamined with the roentgen rays. From the clinical standpoint, all had improved definitely. Notwithstanding this, no roent-

genologic change was apparent in 23 patients, but 15 of these were examined within less than three months after treatment was begun. Improvement was evident in 27, and in several the appearance of the stomach had become quite normal. It has been suggested that, in the process of healing, stenosis and obstruction might be increased by scar contraction, and in one instance the hour-glass seemed narrower than before, but the patient was definitely better in all clinical respects.

FIG. 4. Long, median, hour-glass deformity produced by gastric syphilis.

The most common sign of amelioration was an enlargement of the narrowing with a corresponding diminution of the filling defect. Frequently this expansion of the stenosis came early and suggested relaxation of spasm rather than organic changes. Later, lessening of the deformity became so pronounced as to indicate anatomic change. In this connection it should be pointed out that, as seen with the roentgen rays, the caliber of the stomach, whether normal or diseased, depends at least in part on the degree of distention with barium. Hence, unless the amount of barium given to the patient is the same at each examination, the examiner can deceive himself as to the degree of improvement.

The series would seem to warrant the following general conclusions as to the roentgenologic signs of gastric syphilis:

1. The chief sign is a concentric, symmetric filling defect, affecting both curvatures equally, and narrowing the gastric lumen. Almost constantly the narrowed channel takes a straight or direct course, is never really tortuous, and is relatively smooth, although there may be a few small marginal irregularities, or one or two projecting pockets of some size.

2. In the area of the deformity the rugae are obliterated and the gastric wall is less pliable under the palpating finger.

FIG. 5. Gastric syphilis with diffuse involvement.

Everywhere the margins of the barium shadow are clear-cut and distinct; the whole shadow is of good density yet appears flat and lifeless.

3. In by far the greater number of cases, almost three-fourths of them, the stenosis adjoins the pylorus, from which it extends proximally in varying degrees, but seldom into the cardiac third of the stomach. The barium shadow of the narrowed lumen may have a sharply spicular form with its point toward the pylorus, or it may be regularly cylindrical.

4. Second in frequency, but occurring in less than a fourth of the cases, is the hour-glass or dumb-bell type, in which the constriction is centrally situated, the

pyloric and cardiac ends remaining free. Although variable as to width and length, the contracted canal is most often quite long. In this event it is rather peculiar to syphilis, and it has been exploited as such. Unfortunately, cases marked by this sign make up a small minority of the total number.

5. In a third type, comprising less than a tenth of the cases, virtually the entire stomach is affected. The viscus is converted into a narrow, rather smooth tube, the width of which varies among individual cases. Although the cardiac end is involved, it continues to be more or less distensible. There is little or no longitudinal contraction, with shortening of the stomach. The whole picture is practically diagnostic of syphilis.

6. Sluggish peristalsis in the uninvolved portion of the stomach and lack of peristalsis in the affected area are common to all types. Residues from the six-hour meal and gastric dilatation above the stenosis are rare. Mobility of the stomach is maintained. Shortening of the stomach seldom occurs. Occasionally, as a result of gastric stenosis, the esophagus is dilated, but it is not invaded by extension of the disease. A striking feature is the absence of a palpable mass corresponding to the defect.

In the differential diagnosis, cancer, fibromatosis, hypertrophy of the pyloric ring, gastric ulcer, and gastrospasm from extrinsic causes may require consideration.

Scirrhous cancer has many points of resemblance to gastric syphilis of the prepyloric type and may simulate it exactly. Quite often, however, the filling defect of a cancer is not symmetric, the canal through the affected portion is tortuous, not only is the gastric cavity intruded on by the growth, but the stomach is also likely to be shortened, fixation by extragastric extension of the growth is common, retention of the six-hour meal occurs frequently, and a mass can almost invariably be felt.

Hour-glass deformity produced by cancer of the median segment usually lacks the symmetry of a syphilitic hour-glass, and the canal tends to be more devious. Involvement of the cardiac end may be dominant, and the growth may implicate the esophagus.

As a rule, there are obvious clinical differences, of which the examiner may properly take cognizance. The typical patient with gastric cancer is beyond forty, looks gravely ill, is cachectic, and has a palpable tumor corresponding in size and site to the roentgenologic deformity. The typical patient with gastric syphilis is less than forty, is thin but not weak or markedly ill, is not cachectic, and has no palpable mass in relation to the defect.

Fibromatosis is variously regarded as a scirrhous cancer of low malignancy, or a nonmalignant fibrosis, or as a term applicable to both conditions. If it is a scirrhous cancer the differential criteria already mentioned apply to it, although less aptly because of its preponderatingly fibrous nature. If it is a pure fibrosis, it could hardly be distinguished roentgenologically from syphilitic fibrosis, but the new question then arises of how frequently so-called fibromatosis is really gastric syphilis.

Hypertrophy of the pyloric musculature and early gastric syphilis of the prepyloric type simulate each other closely. Both produce a concentric, symmetric filling defect, a conical antrum and a sense of resistance but not a definite tumor. However, pyloric hypertrophy is likely to be associated with gastric or duodenal ulcer, either of which should be apparent; the thickened wall retains a degree of flexibility; the gastric rugae may remain; the pylorus is never gaping, but, on the contrary, the outflow is scant; retention from the six-hour meal is more likely to occur, and the stomach is more often enlarged.

Distinction between simple ulcer and syphilis, although not difficult ordinarily, is sometimes hard to make. A gastric ulcer with a marginal niche projecting beyond the normal boundary of the stomach is easy to identify. If it gives rise to hour-glass contraction, the narrowed channel is likely to be short and near the lesser curvature, so that the deformed stomach has a B-shape quite unlike the typical, long, dumb-bell deformity of syphilis. But the deformity often produced by prepyloric spasm accompanying ulcer with-

out a visible niche has some similarity to the deformity produced by syphilis of the prepyloric type, especially as the evidence of a lesion is fairly definite and no tumor can be felt. However, antral deformity caused by ulcer is often lacking in symmetry, and the margins of the channel are indistinct. Six-hour residues occur in almost half the cases of ulcer, and the pylorus is seldom gaping. In the sole case of this series in which two ulcers without infiltration were found at operation, there was a spastic antral deformity, but the roentgenologic diagnosis was ulcer. Whether few or many round ulcers are fundamentally syphilitic, the roentgenologist cannot distinguish them from nonspecific ulcers.

Spasm of the antrum from extrinsic causes may bear a marked resemblance to prepyloric syphilis, but the spastic deformity is likely to change in appearance during examination and will usually disappear after the administration of an antispasmodic.

Despite numerous stimulants, it is possible to make the roentgenologic diagnosis of gastric syphilis in a high percentage of cases. The long, central hour-glass, and the diffuse deformity converting the stomach into a narrow tube without shortening are virtually pathognomonic. Symmetric narrowing of the prepyloric segment without a palpable tumor should always suggest the possibility of syphilis. This disease is to be thought of when a patient has a lesion resembling scirrhous cancer but is relatively young. It is to be considered also when a patient notwithstanding extensive disease of the stomach, is neither cachectic nor proportionately weakened.

There is no pretense that the roentgenologic diagnosis can be absolute and final; that can be reached only by considering all the evidence from all sources. But by directing the clinician's attention to this angle of investigation and by co-operating with him, the roentgenologist can aid in the discovery and, indirectly, in the proper treatment of an increasing number of cases (Figs. 1 to 5).

## ABSTRACT OF DISCUSSION

DR. G. W. HOLMES, Boston. It is only within rather recent times that pathologists have accepted the diagnosis of syphilis of the stomach. The pathologist in our hospital, who is considered a leading man, was a long time in accepting the fact that syphilis of the stomach did occur, but he now fully accepts it. I think there are no cases on record in our clinic where a positive demonstration of the spirochete in the stomach has been made, although the pathologists do make a fairly definite diagnosis of syphilis of the stomach from the histologic findings. In 1924 Dr. Merrill reviewed the cases at the Massachusetts General Hospital and published the results in our Journal. He is here today and will review the results a little later. Since then I have reviewed the cases up to the present time. Dr. Merrill found 10 cases in approximately 18,000 gastric examinations. Since then we have probably done an equal number of gastric examinations and I was able to find only one case. That runs somewhat parallel with other syphilitic lesions in our clinic; that is, we are not seeing so many advanced syphilitic lesions as we formerly did. Syphilis of the shin, for instance, is rather rare now whereas it used to be quite common. I agree with Dr. Moore with regard to both the clinical and roentgen-ray findings in this disease.

DR. A. S. MERRILL, Manchester, N. H. I am glad to note that the findings reported by us in cases of gastric syphilis have been practically confirmed in Dr. Moore's paper. In a review of 18,000 gastric examinations in our clinic at the Massachusetts General Hospital, 48 cases were noted in which syphilis was suspected either from the clinical or the roentgen findings. Of these, 32 were eliminated on sufficient grounds. The remaining 16 were positively syphilitic. In 10 the evidence is so strong that they may be accepted without reserve as positive syphilitic lesions of the stomach. In 4 the picture is very suggestive; the other 2 I believe to be cases of coincident benign ulcer in syphilitics, although the evidence of an active syphilitic infection is so positive that it cannot be ignored as a possible etiological factor in the gastric condition. We concluded from our study that gastric involvement is a late manifestation of syphilis and that it is rare, but probably not so uncommon as has been supposed. The diagnosis rests upon history of infection, positive Wassermann reaction, the demonstration of a gross gastric lesion and cure or definite improvement under antisyphilitic treatment. Absence of history or signs of syphilis and a negative Wassermann reaction do not exclude, nor does a positive Wassermann reaction prove absolutely, the syphilitic nature of the condition. The diagnosis is indefinite. We have a picture clinically resembling ulcer

but roentgenologically and even surgically sometimes, the appearance is more that of malignant disease. An important point which Dr. Moore mentioned and which we noted, is the lack of relation of the patient's general physical condition to the degree of involvement of the stomach. In other words, the patient does not appear to be so ill as would be the case with an equal gastric involvement due to carcinoma. We noted that the gastric involvement is usually one of two types: that is, the pyloric type or the extreme hour-glass shape of the stomach to which Dr. Moore applies the suggestive term "dumb-bell stomach."

Dr. Merrill then showed a number of slides illustrating gastric syphilis.

Dr. Percy Brown, New York City, asked Dr. Moore if any observations had been made at the Mayo Clinic indicating the relationship between the incidence of gastric syphilis and the gastric crises of tabes dorsalis.

Dr. L. A. Rowden, England. I find this paper of Dr. Moore's very helpful. A few days before leaving England I ventured to diagnose a case as syphilis of the stomach as against the diagnosis of malignant disease at the pylorus. The appearances were very similar to those described by Dr. Moore and also to the first slide shown by Dr. Merrill. In our country we have been aware of a small number of cases during an experience in gastrointestinal work since about 1901. We have encountered perhaps 20 to 30 cases in all and have labeled these cases "leather-bottle stomach" or linitis plastica. This condition has been looked upon in our country as an old form of malignancy. It seems to me that we often mistakenly diagnose malignancy at the pylorus in cases which give similar findings to those here presented and which after a partial gastrectomy recover and live for many years. It seems likely that a considerable proportion of these cases reported cured by operation have been in reality cases of gastric syphilis.

Dr. H. K. Pancoast, Philadelphia, asked Dr. Moore if he knew of any statistics setting forth the frequency of carcinoma of the stomach in syphilities. We all know the frequency with which carcinoma follows syphilitic lesions in other regions. This is possible also in the stomach. In the first case shown by Dr. Moore and also the first one shown by Dr. Merrill there were prepyloric lesions. Would it be advisable in a case of that kind to do a partial gastrectomy because of the possibility of carcinoma following at a later time?

Dr. James W. Hunter, Jr., Norfolk, Va., asked Dr. Moore if he had any information with regard to the incidence of gastric syphilis in negroes. He stated that he had never known of a case of syphilitic involvement of the stomach in a negro although syphilis is an exceedingly common disease among that race.

Dr. William H. Stewart, New York City, asked Dr. Moore if he could place great dependence as a diagnostic criterion upon the improvement in the appearance of the stomach after antisyphilitic treatment.

Dr. L. T. LeWald, New York City, showed a slide in which a spirochete was demonstrated in a case of gastric syphilis in which an erroneous clinical diagnosis of carcinoma of the stomach had been made. He called attention to the fact that pathologists, unless they are particularly keen, are likely to return a diagnosis in syphilitic stomachs of either inflammatory tissue or tuberculosis. Dr. LeWald also stated that it was his experience that improvement in the appearance of the stomach after antisyphilitic treatment may be depended upon as a very definite diagnostic sign. Dr. LeWald also showed a case of a syphilitic stomach in which there was a definite palpable tumor mass. He believes that a palpable tumor is not a common finding in gastric syphilis but the presence of such a tumor does not serve to rule out this disease.

Dr. E. H. Skinner, Kansas City, Mo., cited one of his own cases with a dumb-bell shaped stomach in a patient with a positive Wassermann. She showed some general improvement under antisyphilitic treatment and at the expiration of six months, operation showed that the condition was carcinoma. He believes that exploratory operation should be performed on all cases with such filling defects.

Dr. Moore (closing). In answer to Dr. Brown's question with regard to the relation of gastric syphilis to crises in tabes, he stated that it was his general impression that patients with gastric syphilis had few other manifestations of syphilis either in the central nervous system or in other parts of the body. He had noted that a majority of patients with gastric syphilis were ignorant of the fact that they had ever had a syphilitic infection. For this reason most of them had never been treated for syphilis. He stated with regard to linitis plastica that one of the pathologists had reviewed all of their cases some years ago and had concluded that they were all carcinomatous.

With regard to Dr. Pancoast's question concerning the occurrence of gastric carcinoma in patients with syphilis, he stated that he was entirely unable to answer it. He agreed with Dr. Skinner that a localized gastric lesion even if syphilitic in nature, would better be resected. So far as he knew, none of the cases in his

series had developed carcinoma. In answer to Dr. Stewart's question he stated that he considered the therapeutic test a very satisfactory one. The improvement in the appearance of the stomach is often rapid although the general clinical improvement is usually in excess of demonstrable change in the stomach. Dr. Moore emphasized the statement made in his paper that the presence of a demonstrable tumor mass is very rare in gastric syphilis.

# ROENTGEN THERAPY OF BRAIN TUMORS, WITH SPECIAL REFERENCE TO ASTROCYTOMAS

BY PAUL MARTIN, M.D.

BRUSSELS

ROENTGEN-RAY treatment of brain tumors, although the subject of valuable contributions from neurologists and roentgenologists of various countries, is still a subject of discussion and more information is needed concerning this therapeutic method.

When reading the observations related in the various papers written on roentgen therapy, one is impressed by the fact that objective evidence is scarce and that ofttimes the decision for roentgen-ray treatment is based upon personal confidence, upon fear of the danger of surgical interference, or upon the idea that the condition being hopeless, any therapeutic means is worth trying.

It is sufficiently demonstrated that roentgen rays have a favorable influence on some cases, but on the other hand, many cases are little or not at all modified, and not a few are made worse. Nevertheless there are a few points upon which there is general agreement:

1. It is better to perform a decompressive operation before applying a roentgen-ray treatment in order to avoid the hypertension which may follow the irradiation (Bremer, Jüngling, Laruelle, Gilbert, Towne, Coste).

2. The pituitary adenomas are favorably influenced, while the tumors of Rathke's pouch do not yield to roentgen therapy (Bailey, Bremer, and Sluys).

3. The meningiomas and acoustic tumors are not influenced (Bailey, Roussy, Laborde, Lévy, etc.).

As to the large group of gliomas, although one can surmise that the law of Bergonié and Tribondeau may be applied to such tumors as well as to tumors elsewhere in the body, only very few reports have been made to confirm this point of view.

Roussy, Laborde and Lévy[1] reported 5 verified cases of gliomas submitted to roentgen treatment. Not one of the cases yielded to treatment. Two of them were certainly of the astrocytoma group and the authors suggest that astrocytomas must be uninfluenced by radiation. One of the cases presented recently by Laruelle,[2] probably an astrocytoma protoplasmaticum, has been improved by the first two series of roentgen treatments (Dr. Sluys), the third one being unavailing.

The cases with histological verification being scarce, a report of 3 cases of astrocytoma upon which the roentgen treatment had no effect may be of some interest.

## CASE REPORTS

CASE 1. Lea D., aged thirty-two, admitted June 20, 1925.

Family and past history were without particular incident, aside from an appendix operation in October, 1924. In December, 1924, she had a fainting spell of short duration. In March, 1925, following a fainting spell, she had severe frontal headaches from which she had suffered since. On getting up in the morning she was obnubilated, walked with difficulty, and her speech was indistinct. Her vision had diminished progressively since April, 1925. Before her entrance into the hospital, the patient had been for three days in a subcomatose state.

*Neurological Findings.* Bilateral choked discs more pronounced on the left; anomia and

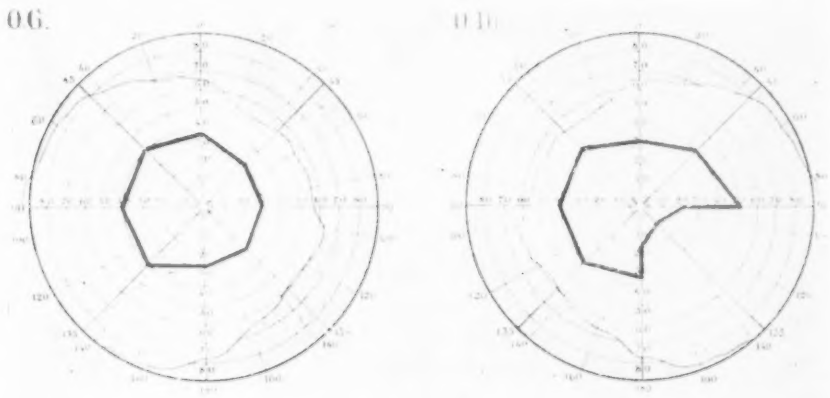


FIG. 1. Case 1. Visual fields showing narrowing of the fields and defect in the right lower quadrant of right eye.

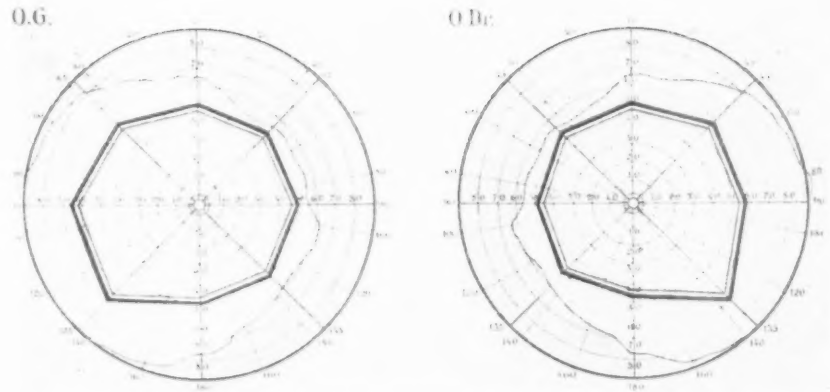


FIG. 2. Case 1. Normal perimetric fields after operation.

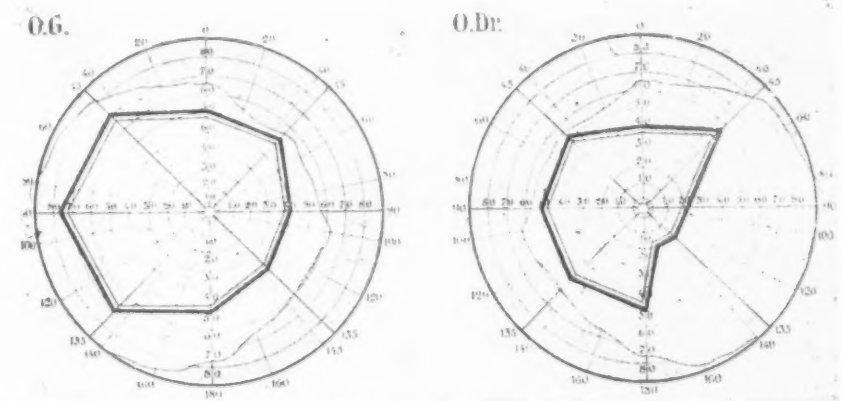


FIG. 3. Case 1. Perimetric fields six months after operation. The left eye remained well. In the right there is a tendency towards hemianopsia.

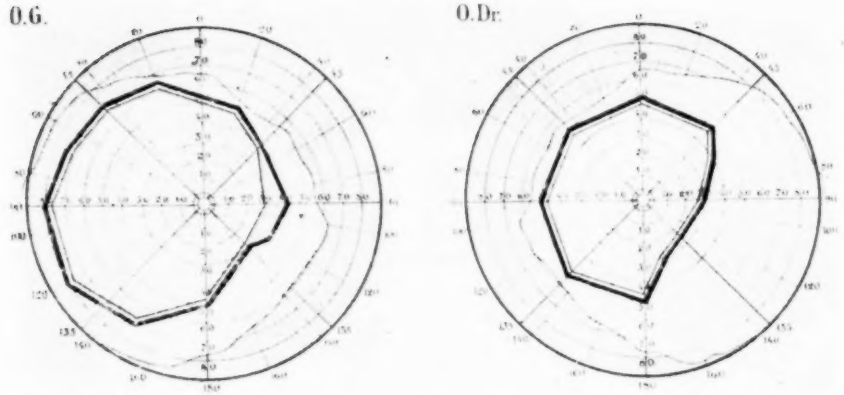


Fig. 4. Case 1. Visual fields fifteen days after the completion of the roentgen-ray treatment. There is no improvement on the right. Hemianopsia is perhaps progressing in the right lower quadrant of the left eye also.

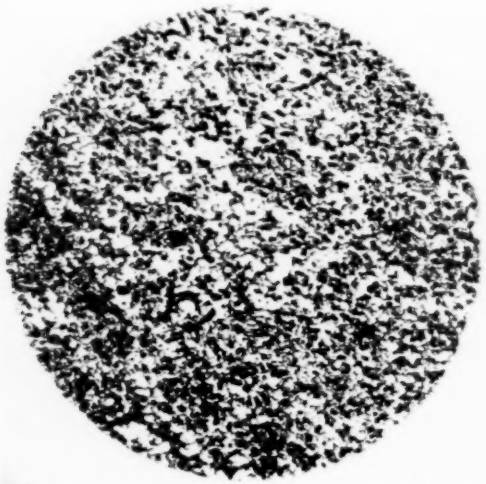

Fig. 5. Case 1. Low power photomicrograph of tumor. Phosphotungstic acid, hematoxylin stain.

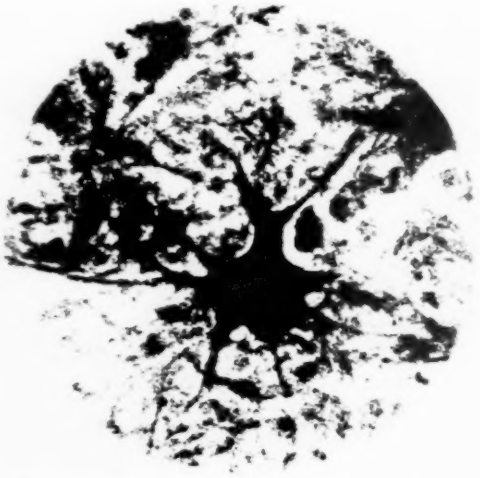

Fig. 6. A giant astrocyte in tumor of Case 1. Cajal's gold sublimate method. (Oil immersion.)

alexia. Visual field defect in the right lower quadrant (Fig. 1).

*Clinical Diagnosis.* Tumor of the left temporo-parietal region. *Operation* (June 23, 1925) consisted in a left osteoplastic procedure combined with a subtemporal decompression. In the lower part of the parietal lobe a gliomatous cyst was evacuated by puncture. There was no surface lesion, the tumor being deeply located; the cyst was reached at 5 cm. from the surface.

*Postoperative Course.* The patient did very well after the operation; she was speaking freely; could write as well as before her illness and the fundi and visual fields returned to normal (Fig. 2). She remained well until Nov. 18, 1925, when she had a recurrence of aphasia. The fundi were normal at this time but the perimetric examination showed a large temporal defect on the right (Fig. 3). There were no signs of intracranial pressure and it was decided to try roentgen treatment, which was given at the "Tumor Center of Brussels University" (Dr. Murdoch). A current of 180,000 volts was used, 4 ma., 40 cm. target skin distance, filtered through 0.5 mm. Cu and 1 mm. Al. The roentgen rays were given through three fields of irradiation with a dose of 650 R (German scale) per field.

This treatment did not bring about any improvement. The agraphia, alexia and aphasia were not modified and the hemianopsia progressed in spite of the application of roentgen rays (Fig. 4). Since then the patient has been re-operated three times with partial extirpation of the tumor, each time with improvement lasting about six months.

*Microscopical Examination.* The tumor is

FIG. 7. Case II. Photograph of the brain showing the huge tumor extending in the centrum ovale of both hemispheres.

almost wholly composed of astrocytes with scant fibrillae (Fig. 5). There are a few giant astrocytes scattered in the preparation (Fig. 6). Blood vessels are rare.

*Diagnosis.* Astrocytoma protoplasmaticum.

CASE II. F. D., male, aged thirteen and a half, admitted Nov. 12, 1925. Past history negative except for a running ear of long duration. The patient came from the medical service where he was admitted at the beginning of November. He had been working up to the time of his entrance to the hospital.

The onset was very abrupt, with headaches and difficulty in walking. Before entering the hospital he had several convulsive seizures; following the last of these, the day before entering the hospital, he became aphasic. Three days after being admitted to the wards he developed suddenly a paralysis of the right arm and a right facial paresis of the cortical type.

*Neurological Positive Findings.* The patient was physically well developed; he understood questions well, but was unable to talk, uttering only a few unintelligible words. Bilateral choked discs were present with a facial paresis on the right side, and palsy of the right upper extremity with impaired sensation. The lower extremities were normal. Nothing abnormal in the cerebrospinal fluid or blood.

*Pre-operative Diagnosis.* On account of the marked obnubilation and the running ear, a tentative diagnosis was made of an abscess of the lower Rolandic region.

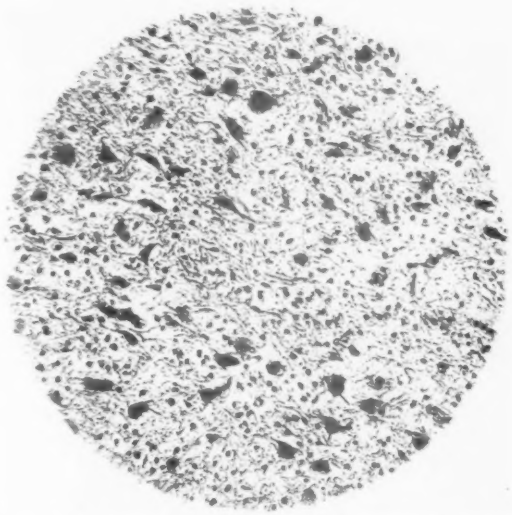

FIG. 8. Case II. Photomicrograph of tumor. Phosphotungstic acid, hematoxylin stain.

*Operation* (Nov. 14, 1925). This consisted in a left osteoplastic exploration combined with a decompression. The operation disclosed no surface lesion. A puncture at the presumed

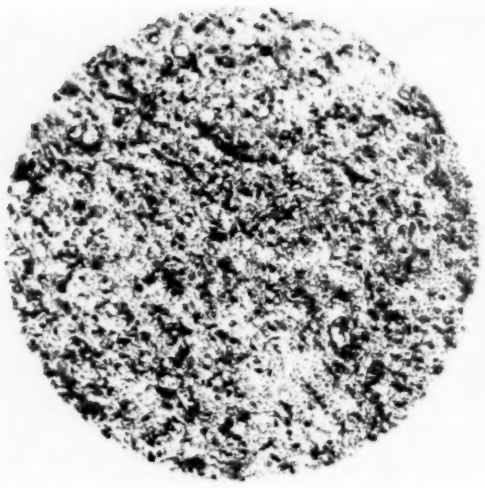

Fig. 9. Case III. Low power photomicrograph of tumor. Phosphotungstic acid, hematoxylin stain.

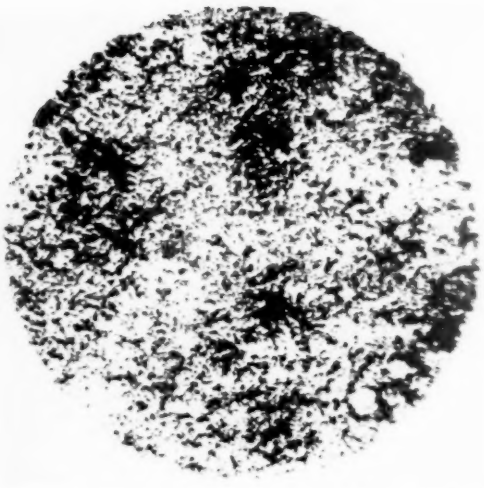

Fig. 10. Case III. Cajal's gold sublimate preparation, showing astrocytes.

site of the abscess gave 40 c.c. of xanthochromic fluid. The ventricle on the operated side was reduced in size. The operative diagnosis was that of a large subcortical glioma.

*Postoperative Course.* The patient did relatively well after the operation, although the focal symptoms were not improved.

*Roentgen Treatment.* On Dec. 24 the patient was transferred to the "Tumor Center of Brussels University" (Dr. Murdoch) and treated with a current of 180,000 volts, filtration 0.5 mm. Cu + 1 mm. Al, a total dose of 1650 R (German scale) being given through three fields of irradiation, during a period extending from Dec. 16 to Dec. 22, 1925. The treatment did not influence the patient's condition and he died on Jan. 3, 1926.

*Postmortem Examination.* The brain shows on horizontal section that the centrum ovale of both hemispheres is occupied by a soft granular whitish tumor (Fig. 7).

*Microscopical Examination.* There is an abundant network of gliofibrillae in which are scattered large astrocytes, some of them plurinucleated, many of them undergoing hyaline degeneration. Blood vessels are rare (Fig. 8).

*Pathological Diagnosis.* Astrocytoma fibrillare.

Case III. This patient was referred to me by Dr. Bremer. His past and family histories were negative. The onset dated from the end of 1925, with Jacksonian fits, starting in the right thumb. In February, 1926, the patient was operated on in Utrecht, a large flap being elevated on the left and the bone removed. After the operation the Jacksonian fits did not subside and progressively the patient developed a paralysis of the right arm. During the summer of 1926 aphasia and apraxia appeared.

*Roentgen treatment* (Dr. Sluys) was given with a current of 180,000 volts, 3 ma., target skin distance 40 cm., filtration 0.5 mm. Cu + 1.0 mm. Al, from Oct. 19 to Nov. 6, 1926, through four fields of irradiation, each field receiving 4000 French R; one of the fields received an additional dose of 1500 R; altogether the dose was 17,500 French R.

This treatment did not bring about any improvement. The patient's condition grew worse; he was suffering from excruciating headaches, and the lower extremity on the right became paralyzed. Meanwhile there appeared a bulging of the operative defect and it was decided to re-explore the old wound hoping to find a cyst and relieve the patient by emptying it, but at operation an infiltrating growth invading almost the whole left hemisphere was disclosed. The new-formed dura, which was more than 1 mm. thick, was removed.

Following the operation (Dec. 1, 1925) the patient improved slightly for a few months; there was some return of speech; he seemed brighter and more cheerful, but this was only temporary; he is now in a helpless condition.

*Microscopical Examination.* The operative specimen shows a great number of large stellate cells with hardly any fibrillary processes (Fig. 9). The cells are identified as astrocytes with Cajal's gold sublimate method (Fig. 10). The collagen is very scanty. The vessels are more abundant than is usually the case in astrocytomas; this we attribute to the fact that the specimen was taken in the vicinity of the cortex.

*Pathological Diagnosis.* Astrocytoma protoplasmaticum.

COMMENT

This report is a clinical application of the work of Bailey and Cushing. The 3 cases presented above were identified as astrocytomas, following the classification of gliomas they recently introduced.

As the astrocytomas are of the most differentiated group of gliomas, it was quite logical to infer that they would be less sensitive to radiations than other types, such as medulloblastomas and spongioblastomas. Nevertheless the proof of this assumption had to be given and for this reason it was thought to be worth while to relate my experience with these 3 cases.

Case I did not get a very large dose of rays (total dose 2000 German R); Case II had a huge tumor and the total dose of 1650 German R was also slight. Roentgenologists will probably object that such doses are insufficient, but we know from the experience of several authors (Bailey, Sosman, Coste and others) that when a glioma is radiosensitive, it shows at least a temporary improvement even with slight doses.

CONCLUSIONS

1. Three verified cases of astrocytoma are described which were not at all influenced by roentgen treatment.

2. For the appreciation of the effects of roentgen therapy only histologically verified cases ought to be taken into consideration.

3. Before undertaking roentgen treatment of a brain tumor one should at least perform a decompression and every attempt should be made to establish a correct pathological diagnosis.

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# TREATMENT OF MOUTH AND FACE CONDITIONS BY IRRADIATION*

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WHETHER surgery or radiation should be used in the treatment of malignant conditions about the mouth and face is a question which presents many difficulties. At Bellevue Hospital the burden of treatment in such cases has been placed on radiation therapy. The method used is a modified form of the curie therapy as employed at the Curie Institute in Paris.

I shall quote no statistics, nor attempt to compare the method we use with that used by others, as conditions at Bellevue are different from those elsewhere. Seldom are really operable cases seen, such cases in which surgery alone can offer a cure. The principle on which this method is based is: small doses heavily filtered, over a long period of time. We do not use heavy doses repeated at short intervals, nor do we employ unfiltered radiation. While we cannot speak of cures, we feel that this method is giving good palliative results in alleviating the pitiful condition of the patients who come to us.

Treatment of a lesion by radium may be carried out either by local application, by puncture implantation, or by a combination of both.

For local applications, molds made of specially prepared wax are used, in forms and shapes necessary for the condition treated. The active element is enclosed in lead cylinders, equivalent to 1 mm. of

* Read at the Twelfth Annual Meeting, American Radium Society, Washington, D. C., May 16–17, 1927.

platinum filtration. The distance between the radiation focus and the lesion is controlled by varying the thickness of the wax mold.

For the puncture method, needles, seeds and tubes are used. The needles are of platinum or steel, the seeds of gold or platinum, and the tubes of platinum. The steel needles are used now only for hemangiomas, where we want some necrotic effect. The platinum needles are of various sizes, with a filtration of 0.2 and 0.4 mm. The lighter filtration is used in superficial facial growths, small in area and localized, such as small angiomas and nevi. The tubes are of platinum, giving a filtration of 1 and 2 mm. In puncture work, especially in the tongue, we have found that the longer needles, 35 mm. in length, give better and more uniform results than the shorter needles heretofore used. So, too, the results of platinum filtration surpass those obtained with the old style steel or alloy needles. As Failla and his coworkers have shown, hard beta and gamma rays are more effective in producing skin erythema than muscle necrosis. The seeds are of gold or platinum, giving 0.2 mm. filtration. The gold seeds form permanent implantation, the platinum are removable.

Inasmuch as Bellevue Hospital at present owns no radium element, emanation or radon is used, and this is supplied as needed on our prescription.

Where possible, treatment is a combination of deep roentgen rays and radium. The roentgen rays are used first over the lymphatic drainage areas associated with the lesion, and radium therapy follows immediately. In this way, by the combined method it is believed, as Quick and Cutler have shown, that the radiation effect upon resistant tumors is markedly increased, an effect which does not occur when either the roentgen ray or radium is used alone. We feel, too, that in this way the lymphatic channels are blocked off against further dissemination following the local manipulation of the puncture process at the site of the lesion.

In some cases we have attempted to employ block dissection for removal of the invaded lymphatic glands. In only one case have we had a real cure. The others were too far advanced to make operation feasible, even when attempted.

Biopsy is done in all cases, and I do not believe that this in any way harms the patient or increases the risk. As the type cases we see at Bellevue are usually poor, in advanced stages, and badly infected, the prognosis is bad, but we have seen some spectacular results, and nearly all cases benefit by the treatment, even if it is only a transitory palliation.

In tongue cases, following biopsy, irradiation by roentgen rays is applied to the cervical lymphatics, and at the same time mouth disinfection with alkaline washes, followed by methylene blue application is carried out. This reduces to a marked degree the extent of the lesion and spread of infection following needle puncture.

Some marked changes in the extent of involvement occurs following thorough pre-treatment, disinfection and mouth hygiene. All necessary dental work is done at this time, as extractions following treatment may lead to bone necrosis. In this way much of the inflammatory infected induration is eliminated, and implantation with radium is safer and more easily carried out. As previously stated, in some cases where the lymphatic involvement is limited, block dissection of the cervical nodes is attempted before irradiation. The implantation is usually carried out under local anesthesia. The needles, usually 2" to 3½ mm. long, are prepared beforehand according to the plan decided upon. These long needles have the active element distributed throughout their length and when inserted in the tongue give a radiation action over a large area. The shorter needles formerly used irradiated the local condition but failed to act on the surrounding neighboring zone, which might have some malignant foci present that would later be a source of recurrence. Each needle is loaded with 2.5 to 3 mc. of radon. The needles are spaced according to the size of the lesion, and in such position and angles as the position of the lesion requires. They are sutured in position and left in place for from five to ten days, depending on the dosage required, usually 1500 to 4500 mc-hr. The number of needles required

varies with the condition of the lesion to be treated. When the needles are withdrawn there is seldom any bleeding, and the reaction is mild, due to the protection afforded by the platinum filtration. Necrosis seldom occurs. Healing is gradual and usually takes place in four to six weeks.

In lip cases after preliminary roentgen irradiation of the lymphatic areas, needle puncture of the local lesion is done. Platinum needles, loaded with 2.5 to 3 mc. of radon are used. Needles are placed around the lesion, both perpendicularly and horizontally, and sutured in place. After five to ten days they are removed. The subsequent course is usually mild and healing occurs in from four to six weeks.

The carrying of the puncture needles for such a long time is seldom very uncomfortable to the patient. Rarely is more than a quarter of a grain of codeine required to ease the discomfort. Eating of soft and liquid diets is not difficult.

In posterior tongue lesions and in lesions of the tonsil and larynx, where needles cannot be placed without difficulty, we use gold or platinum removable seeds. In our work the gold seeds have proved to be more practicable, being less likely to get lost and being more easily inserted than the removable platinum seeds. Quick and Cutler have described these fully. Transitional cell lesions are treated only by external irradiation and not by puncture.

For large metastatic neck glands not affected by roentgen radiation we use needle implantation. The needles with their long areas of distribution seem to work better and give more favorable results than do the seeds. In some few cases where the mass was very large following irradiation, it was removed with the high frequency knife.

In the case of palate and cheek lesions, inside the mouth, platinum needles are used. Lesions outside the face are treated with wax molds which are specially made for each case. To these molds are attached the active element in lead cylinders which give a filtration equivalent to 1 mm. of platinum. Depending on the character of the lesion, the thickness of the wax mold is varied to increase or decrease the penetration effect. Molds of ½ to 1½ mm. thickness are used. In those cases where deeper penetration is required, needle puncture instead of molds is employed. The dosage varies with the size of the lesion, 1 to 4 mc. per square centimeter.

To protect surrounding structures, as eyes, ears, etc., lead barriers surrounding the radon active section are affixed to the molds. The molds are left in place for five to ten days. The initial dosage is small, but the period of time is extended to produce the required total millicurie-hours.

Lesions in the floor of the mouth offer difficult problems. Frequently the lesion is markedly ulcerated with large sloughing areas, and at the time the jaw bone is already involved, with necrosis of soft tissue extending deep into the neck. Roentgenograms are always taken to show the extent of bone necrosis, before treatment is given. Advanced and hopeless cases are not treated at all.

In the cases we do treat, preliminary roentgen irradiation over the lymphatic drainage areas is carried out before radium therapy is applied. Where possible, we use platinum filtered tubes in the previously cleaned out sloughing cavity. Formerly we did needle puncture in these cases, but on account of the poor results obtained we seldom do so now.

## SUMMARY

In this method use is made of a combination of deep roentgen therapy and irradiation by radium emanation. The radium work is carried out with long platinum filter needles for puncture procedures, and wax molds with heavily filtered applicators for surface applications.

In all cases biopsy is done following preliminary mouth hygiene and disinfection.

Treatment is given in small doses applied over a long period of time and not repeated.

The reaction is never very severe, and necrosis seldom occurs.

# ROENTGEN-RAY AND RADIUM TREATMENT OF PLANTAR WARTS

BY HENRY H. HAZEN, M.D.

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PLANTAR warts are so frequent and usually so painful that any easy and certain method of removal is to be welcomed. The following methods of treatment have been advocated: excision, treatment with various acids, the electric cautery, endothermy, roentgen rays and radium. Excision is frequently followed by recurrences. Caustics are slow, uncertain and frequently very painful. The use of either the actual cautery or of endothermy is invariably followed by discomfort or pain for a period of about three weeks. All the methods named have the serious disadvantage of producing a scar upon the sole. Such scars are sometimes a source of much discomfort. It is a well-known fact that both roentgen rays and radium will usually clear up plantar warts without pain, discomfort or subsequent damage of any type. The following study is based upon 157 consecutive cases that have occurred in private practice.

This condition is much more common in women than in men; in this series of cases 50 of the patients were males and 107 females. The disease is much more frequently encountered in private than in dispensary practice. It is especially infrequent in the negro race. In twenty years of extensive clinical work among members of this race I have never seen an example of this trouble. The disease is more frequent in the young than in the old. In 19 of my patients the age was not recorded. The following table will show the age incidence of the patients.

TABLE I

| Years | Male | Female | Total |
|---|---|---|---|
| 10–19 | 18 | 27 | 45 |
| 20–29 | 14 | 32 | 46 |
| 30–39 | 5 | 18 | 23 |
| 40–49 | 5 | 8 | 13 |
| Over 50 | 4 | 7 | 11 |
| | 46 | 92 | 138 |

In many instances the lesions are multiple. Nineteen males and 39 females had more than one lesion. Both feet were involved in 15 instances. In 6 patients the lesions were very numerous; as many as seventy-five warts being present. The following table will show the distribution of the warts.

TABLE II

| | |
|---|---|
| Ball of toes | 15 |
| Ball of feet | 112 |
| Sole beneath arch | 8 |
| Side of feet | 20 |
| Heel | 28 |

The duration before the patient came under my treatment varied from one month to twenty years, with an average of three months. Nearly two-thirds of the patients had previously been treated by chiropodists. In Washington this treatment has consisted of paring down the wart and then applying silver nitrate. It is not infrequent to find that a patient is totally disabled for a day or two following this procedure.

The pain caused by plantar warts has varied from slight inconvenience to almost complete inability to use the foot. Many patients develop the habit of walking in such a manner that the weight will not fall upon the tender spot. Naturally foot strains are incurred and in long-standing cases these are sometimes serious enough to require the attention of an orthopedic surgeon.

The epidemiology of plantar warts needs further study. We know with a fair degree of certainty that warts are due to some infectious agent and that they are autoinoculable. The conditions which favor their development in the human being are not well understood. As bearing upon this point the following observations may be of some interest. In 10 instances the disease affected from one to 5 members of a family. Five small epidemics have been encountered among the girls attending private schools. In a number of instances the exchange of stockings was an item to be considered, but this was by no

means true in all instances. It seems possible that the bath mat is a causative factor for the spread of this condition just as it is in eczematoid ringworm. The paring of calluses or corns may result in the inoculation of a wart.

In 20 instances patients disappeared from view before the final results could be ascertained. Four of these were males and 16 females. This leaves a total of 46 males and 91 females upon whom the final results of treatment are known.

The average number of treatments was three, although in several instances as many as seven treatments were given. One very striking result of the first treatment was that pain almost completely disappeared between the fourth and sixth day; this has occurred in over 90 per cent of all patients. In many instances at some later date there has been a very slight period of discomfort, but this is rarely severe enough to be annoying.

It is essential that the foot be firmly held during treatment and for this reason I have never had the patient lie upon the abdomen with the knees flexed, so that the soles point upward. It seems better to have the patient either lie or sit upon a table so that the sole is in a vertical position just at the edge of the table. The foot is immobilized by sand bags. A small diaphragm is used in the tube stand and the sole is protected with either lead foil or lead rubber. The opening must be just the size of the wart.

The dosage varies considerably if solitary warts or if large groups of warts are to be treated. In the former instance my technique is as follows: spark gap, 7½ inches, milliamperage, 4; time, 4 min.; focal skin distance, 10 inches. Ordinarily no filter is employed, but if the wart is embedded in a heavy callus 1 or 2 mm. of aluminum may be used to advantage. The interval between treatments should never be less than three weeks. Under no circumstances should treatment be given in the presence of a treatment reaction. A reaction is indicated not by redness but by swelling and pain, sometimes accompanied by a redness of the protected area. Michael[1] has clearly shown that warts should receive at least a 2 unit dose. Where there is a group of warts covering a considerable area, the same technique is employed, except that the time is reduced to two minutes. It is generally recognized that there is much more risk of a roentgen-ray dermatitis when large areas are treated.

In the radium treatment, 20 mg. in needles has been employed. In other words, gamma radiation has always been used. The radium has been allowed to act for from one to one and one-half hours. In a few instances, roentgen-ray and radium treatments have been alternated.

The results from this light dosage are uniformly brilliant and there has not been a single case of unpleasant sequelae. In 2 instances where roentgen-ray treatment was not successful the lesions were cured by radium. In 2 other instances warts were successfully removed by the actual cautery under local anesthesia.

In all, radium was employed in 21 cases; radium alone in 6 cases and the combination of roentgen rays and radium in 15 cases. In 4 instances the results are unknown. One case was a failure and 16 cases resulted in permanent cure.

The roentgen ray alone was used in 136 cases. In 16 instances the result is unknown. There were 8 known failures with the roentgen ray alone. Out of 120 cases in which the final results are known there were 112 cures. When roentgen rays and radium were combined there were but 5 failures in 137 cases.

Wickham and Degrais[2] are credited with being the first to successfully treat plantar warts by means of radium. This publication was in 1912. However, in 1903 Zeisler[3] reported some 40 plantar warts in one individual which were cured by the roentgen ray. Hazen and Eichenlaub,[4] in 1920, reported 16 cases. MacKee[5] refers to 30 cases of which 20 were cured. A few other articles have appeared but the literature is exceedingly sparse.

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# THE PHYSICAL AND CLINICAL FOUNDATIONS OF OVERSOFT ROENTGEN-RAY (GRENZ-RAY) THERAPY

BY OTTO GLASSER, PH.D., AND U. V. PORTMANN, M.D.

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ATTENTION has been called in recent publications[1] to the therapeutic use of soft roentgen rays with an average wave length of from 1 to 3 Angström units. This quality of radiation was first used in therapy by Bucky,[1] who employed a Coolidge tube with a window of Lindemann glass, the potential on the tube being not over 10 kv. Long wave length roentgen rays have been used in physical investigations for many years. From a biological and clinical point of view, Bucky believes that the long wave lengths show certain phenomena similar to those of harder roentgen rays, as well as to those of ultraviolet rays. For this reason he has called these rays with long wave lengths "grenz rays" which interpreted means "boundary rays." For the sake of simplicity we shall use the term "grenz rays" in the following discussion.

Between the longest roentgen rays of about 3 Å and the ultraviolet rays of about 1800 A, which are used in therapy, there is a wide range of wave lengths, the biological reactions to which are entirely unknown. It is possible that in the future the name grenz rays will be found to be inapplicable to this wide range of wave lengths. Recently several authors[1] have reviewed the subject of soft roentgen therapy, and since there has been some discussion as to the practical therapeutic value of grenz rays, we have undertaken an investigation to determine the laws governing their operation.

*Grenz-Ray Apparatus and Grenz-Ray Tubes.* Grenz-ray apparatus and grenz-ray tubes have been described in detail. For our investigation we used a commercial apparatus* for the production of soft rays which was very satisfactory. This apparatus consists of a transformer with both autotransformer and resistance control. The kilovoltmeter and milliammeter are built into the switchboard. The grenz-ray tubes which we used are illustrated in Figure 1 in which A indicates the old unipolar tube used by Stern in about 1910; B is the Müller tube with a chromium iron target. The focus of the Müller tube is a ring which is illustrated by a pinhole camera picture at the left of the roentgenogram of the tube. C is a similar tube constructed by Siemens and Halske. It has a point focus, as illustrated. The target is of tungsten. The last two tubes are of ordinary glass with a Lindemann glass window which transmits most of the rays. Since the window in these tubes is too small to permit the use of large fields, we have constructed in our laboratory water-cooled tubes made entirely of lithium glass, with targets of various materials. These are illustrated in Figure 1, D. All these tubes except the old unipolar tube are very constant and work satisfactorily. It was found that there was a considerable difference in the output of different tubes, even of the same type and manufacture, because of the variety of materials used and the varying thickness of the Lindemann window. On the other hand, the output of the different types of grenz-ray tubes examined was not found to show larger variations than these, and we can therefore conclude that the output of var-

* We are indebted to the Wappler Electric Co. for having very kindly put this apparatus at our disposal.

jous makes of grenz-ray tubes are independent of their construction. We included in our investigations the old type of unipolar of low atomic weight and also transmits the relatively soft rays. Because of the low potentials used (up to 10 kv.) in

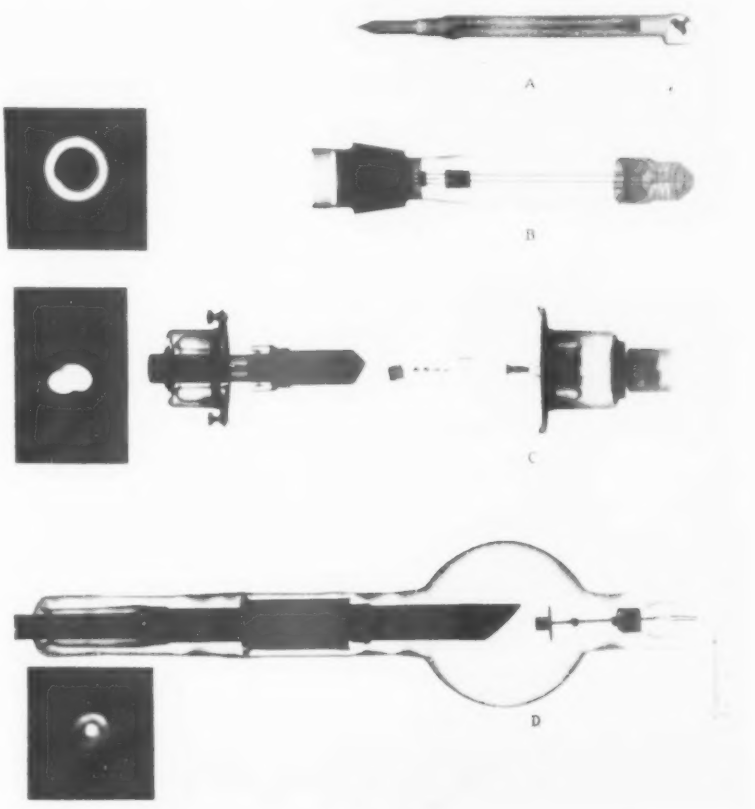


FIG. 1.

tube because of its historical interest. This tube could not be operated at a lower potential than 20 kv. and could therefore produce rays of too great penetration, which are not desirable in grenz-ray therapy. The output of this tube was also very inconstant, making exact measurements almost impossible. It would seem that all of the older gas tubes which were formerly used for soft-ray therapy belong in the same category, that is, they were operated at potentials higher than 10 kv. and were variable in their output.

*Spectrum of Grenz Rays.* Grenz rays are roentgen rays of long wave length which are produced by the special tubes illustrated in Figure 1. These tubes are either made of lithium glass or have Lindemann glass windows. This material is grenz-ray therapy, the limit of the short wave end of the spectrum is about 1 to 3 A. These long wave lengths produce certain characteristic phenomena which must be discussed from a theoretical viewpoint before we proceed to a study of the results of practical physical measurements.

Figure 2 shows several spectra of the grenz rays, as discussed recently by Küstner.[2] Figure 2A is a grenz-ray spectrum from an iron target at 4, 6, 8, 10 and 12 kv., with the rays filtered through a Lindemann window of 0.2 mm.—which is the average thickness of the windows of grenz-ray tubes. These curves show that in the range of the shorter waves, intensity rises rapidly and decreases slowly toward the range of the longer wave lengths. The enormous decrease of intensity with the

potential can also be read from these curves. Of course, these very soft rays are easily absorbed, even by air, and the spectra in Figure 2B illustrate this point. The spectra filtered through 10 and 20 cm. of air are added to the spectra of the unfiltered rays and voltages of 10 and 6 kv., as shown in Figure 2A. It can be seen that the softer components of the spectrum, especially, are easily absorbed by air.

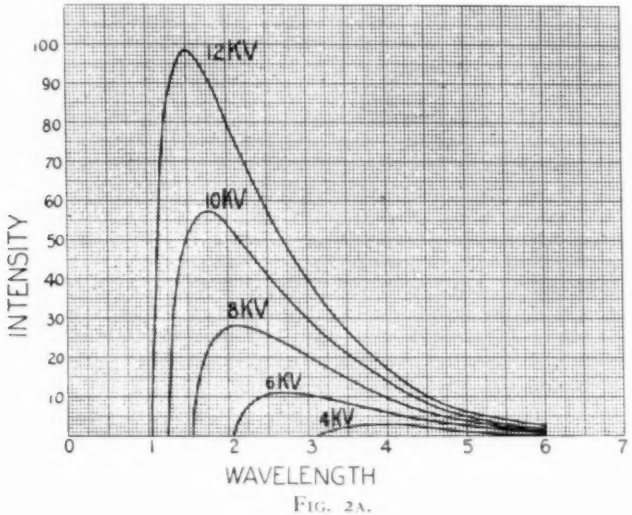


FIG. 2A.

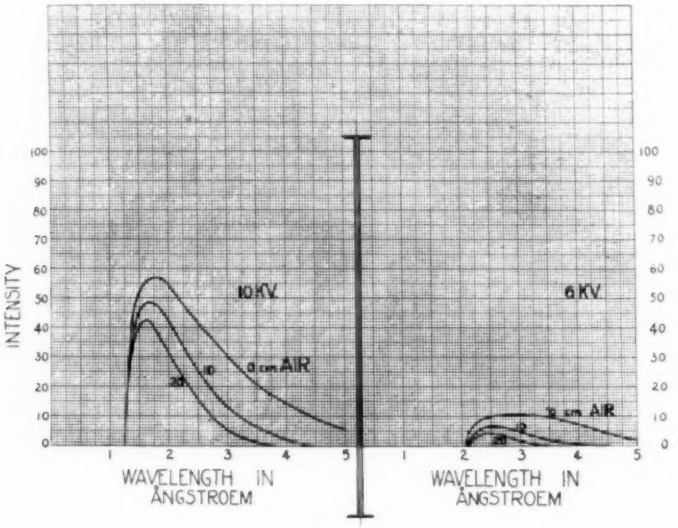


FIG. 2B.

At present we are investigating the spectral distribution of the grenz rays, although we have not yet come to sufficiently accurate conclusions to include this study in this report. For this investigation we have used the absorption in aluminum as an indicator of the quality of radiation. From Allen's absorption data we have calculated the half-value layers in millimeters of aluminum, in their relation to the average wave length, as well as the half-value layers in millimeters of air. The two curves illustrating these data are shown by A and B in Figure 3.

*Determination of Radiation Qualities*—

*Indirect Method.* At the present time, for practical purposes, only the indirect methods of measuring the quality of grenz rays are used, that is, the kilovoltmeter or the spark and sphere gap. On account of variations in tubes, it is advisable, however, to attempt to use only the direct quality determination, as referred to in the next section. We attempted to measure the voltage by various methods, namely, by a kilovoltmeter, a spark gap with needle points, sphere gaps with 5 cm. and 12.5 cm. spheres, and an electrostatic voltmeter which is calibrated up to 10 kv. (Central Scientific Co. of Chicago). The kilovoltmeter readings are not always reliable and must be controlled by a sphere gap. The needle points (sewing needles No. 00) are also unreliable and sphere gap readings are to be preferred. The 5 cm. or the 12.5 cm. sphere gap can be easily used. The voltages were measured in peak kilovolts by calibrations from well-known data, as illustrated in Figure 4.

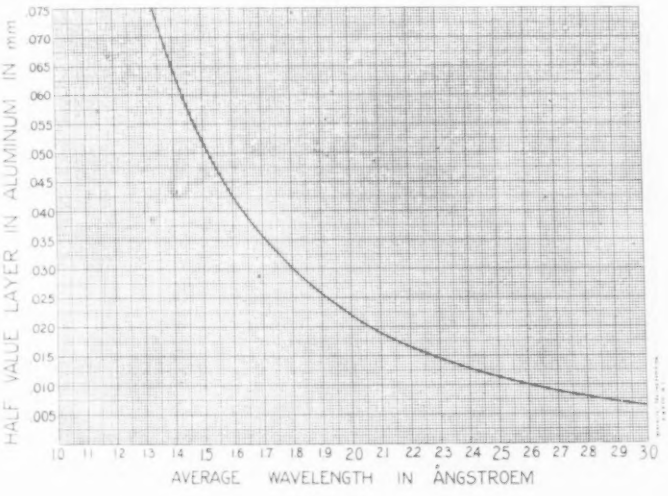


FIG. 3A.

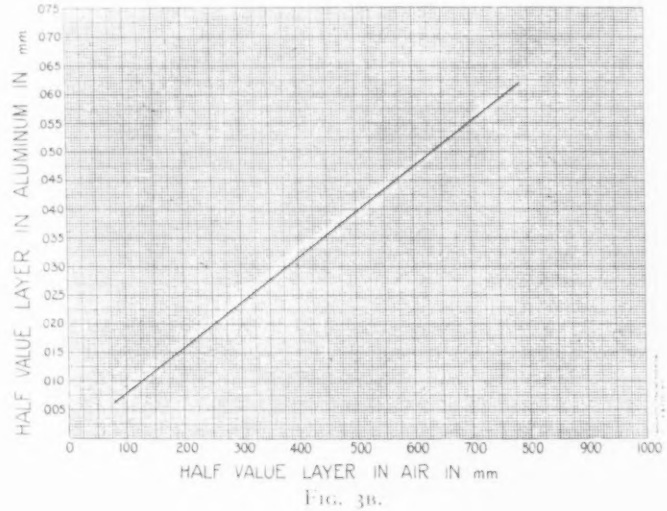


FIG. 3B.

*Direct Methods.* In measuring the quality of grenz rays, the direct method is preferable. In addition to the method of

determination of the quality by the spectrum, to which we have already referred, the absorption in a particular material may also be used as a direct indicator of quality. For this purpose we used aluminum foil,* of 0.012 mm. in thickness, the aluminum proving to be superior to celluloid, cellon, paper, or any of the other materials which were investigated. We made complete absorption curves for aluminum, using the small ionization chamber of goldbeater's skin which is described in one of the following paragraphs.

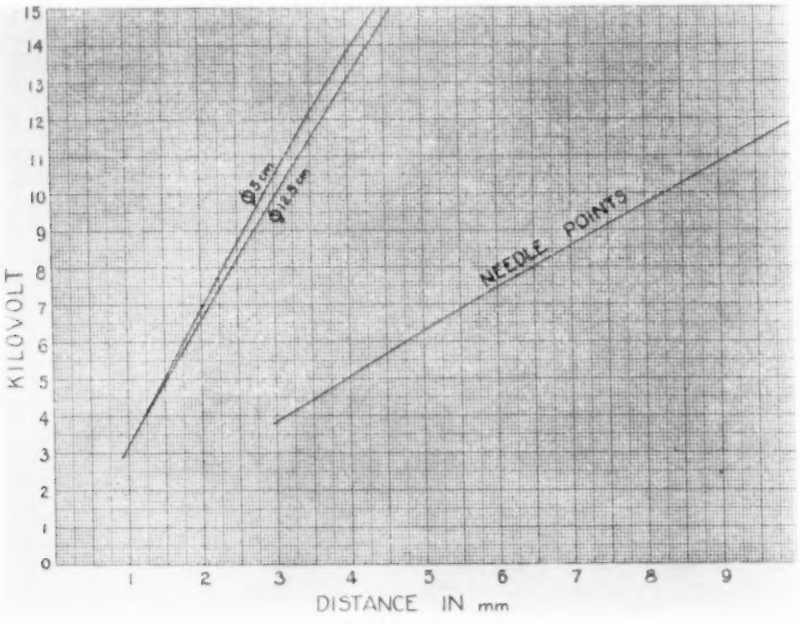


FIG. 4.

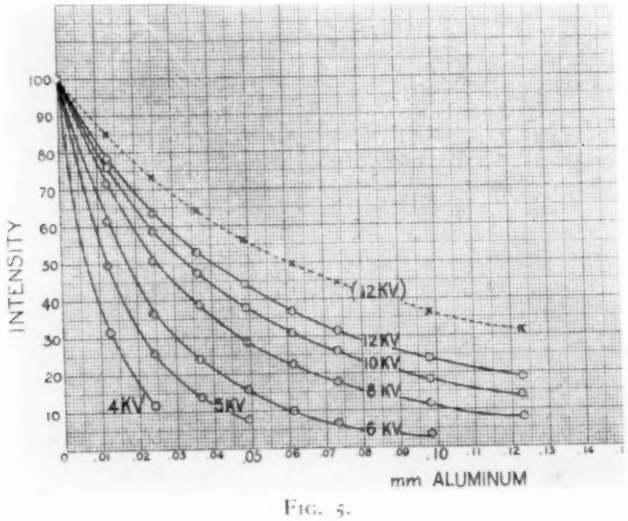


FIG. 5.

This chamber is 1 c.c. in volume and permits us to measure the intensity of

* We wish to express our appreciation of the courtesy of the Aluminum Co. of America for supplying us with the pure aluminum foil used in these experiments.

radiation independent of wave lengths within the range of grenz rays; it also shows no appreciable absorption of grenz rays down to a voltage as low as 4 kv. The absorption curves as experimentally determined are illustrated in Figure 5. They were made with a Müller tube, with a distance from the window to the chamber of 4 cm., that is, the distance from the focus to the chamber was 9.6 cm.; the voltages used were of 4, 5, 6, 8, 10 and 12 kv., and the strength of the current was 10 ma. For comparison we have added the absorption curve for aluminum made with an ordinary Coolidge tube operated at 12 kv. Similar absorption curves have also been made with types of soft-ray tubes other than the one described.

Table 1 illustrates the half-value layer in millimeters of aluminum for various qualities of radiation. Observations were made with a distance of 4 cm. from the window to the chamber, and also under the same conditions with a distance of 20 cm. from the window to the chamber, that is, of 25.6 cm. from the focus to the chamber.

TABLE I

HALF-VALUE LAYER IN MM. ALUMINUM FOR GRENZ RAYS
Müller tube; chromium iron target; 10 ma.

| E.m.f., Kv. | Half-value Layer in Mm. Aluminum | |
|---|---|---|
| | 4 Cm. Distance (Window Chamber), Mm. | 20 Cm. Distance (Window Chamber), Mm. |
| 4 | 0.007 | |
| 5 | 0.0125 | |
| 6 | 0.0175 | 0.0195 |
| 8 | 0.0250 | 0.0315 |
| 10 | 0.0335 | 0.0435 |
| 12 | 0.0400 | 0.0610 |

A graphic representation of these data is given in Figure 6. A translation of these half-value layers into average wave lengths is made by means of the data in Figure 3. These average wave lengths are collected in Table II, together with the minimum wave lengths of the different bundles as calculated from the peak voltages by Duane-Hunt's law.

Some interesting observations may be made from the data in this table. The increased distance "hardens" the bundle, according to Roentgen's law of absorption, since the air absorbs the softer components

TABLE II

AVERAGE AND MINIMUM WAVE LENGTH OF GRENZ RAYS
Müller tube; chromium iron target; 10 ma.

| E.m.f., Kv. | Average Wave Length in Å | | Minimum Wave Length Length in Å |
|---|---|---|---|
| | 4 Cm. Distance (Window Chamber) | 20 Cm. Distance (Window Chamber) | |
| 4 | 3.0 | ... | 3.0 |
| 5 | 2.5 | ... | 2.5 |
| 6 | 2.2 | 2.1 | 2.1 |
| 8 | 1.9 | 1.8 | 1.5 |
| 10 | 1.7 | 1.6 | 1.2 |
| 12 | 1.6 | 1.5 | 1.0 |

to a greater extent than the harder ones. This is well shown, especially in the curves in Figure 6. For the 5 kv. bundle the difference in distance does not amount to so much as for the 10 kv. bundle; the former is relatively homogeneous after having passed through the window, while the latter contains many more soft components which can be absorbed more readily by the air than can the harder ones, and thus cause the bundle to become "hardened."

The importance of quality determination for the practical use of the grenz rays is apparent, and only the direct measurement of the quality at the site of the application of the rays should be accepted, since many factors, especially the absorption of the rays in the air, play an important rôle in this determination.

A table of half-value layers and average wave lengths for other conditions of radiation therapy may be of interest here (Table III).

TABLE III

HALF-VALUE LAYERS AND AVERAGE WAVE LENGTHS FOR DIFFERENT CONDITIONS OF RADIATION THERAPY

| E.m.f., Kv. | Filter | Half-value Layer in Mm. Aluminum | Average Wave Length in Å |
|---|---|---|---|
| 4 | grenz-ray therapy | 0.007 | 3.0 |
| 10 | | 0.0335 | 1.7 |
| 20 | | 0.15 | 1.1 |
| 30 | | 0.2 | 0.9 |
| 50 | skin therapy | 0.4 | 0.8 |
| 100 | | 1.0 | 0.5 |
| 130 | medium therapy | 2.0 | 0.4 |
| 130 | 4 mm. Al | 5.0 | 0.3 |
| 200 | 0.75 mm. Cu, deep therapy | 13.0 | 0.15 |

*Absorption in the Human Skin.* The

absorption or penetration of this quality of grenz radiation in the human skin is of particular interest in its practical therapeutic application. It has been previously stated that the average absorption of tissues for the soft rays is about equal to that of water. Recently Frank[3] has calculated from their chemical composition the average absorption of various kinds of tissue such as the epidermis, muscle, etc.

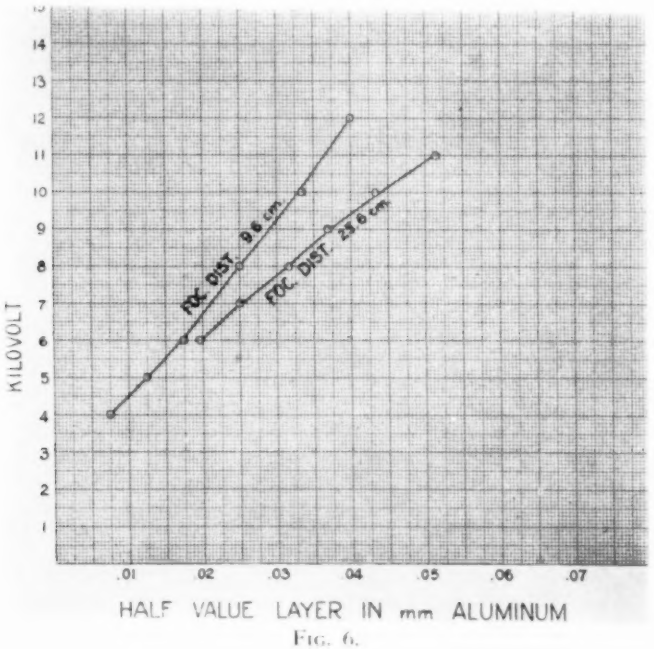


Fig. 6.

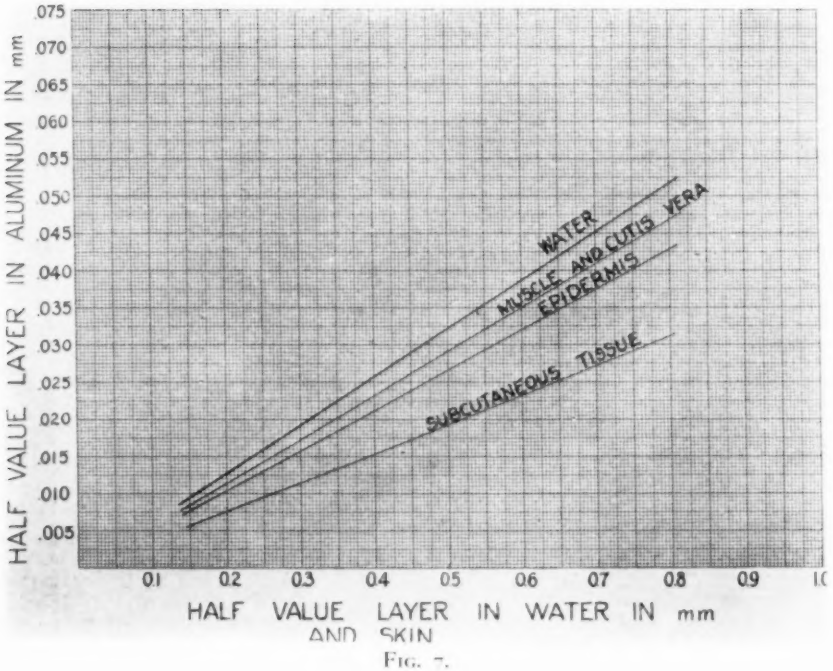


Fig. 7.

From these data we have determined the half-value layer in water, muscle, cutis vera, epidermis and subcutaneous tissue in conditions this half-value layer is 0.03 mm. of aluminum, then from Figure 7 we see that half of this radiation is absorbed in

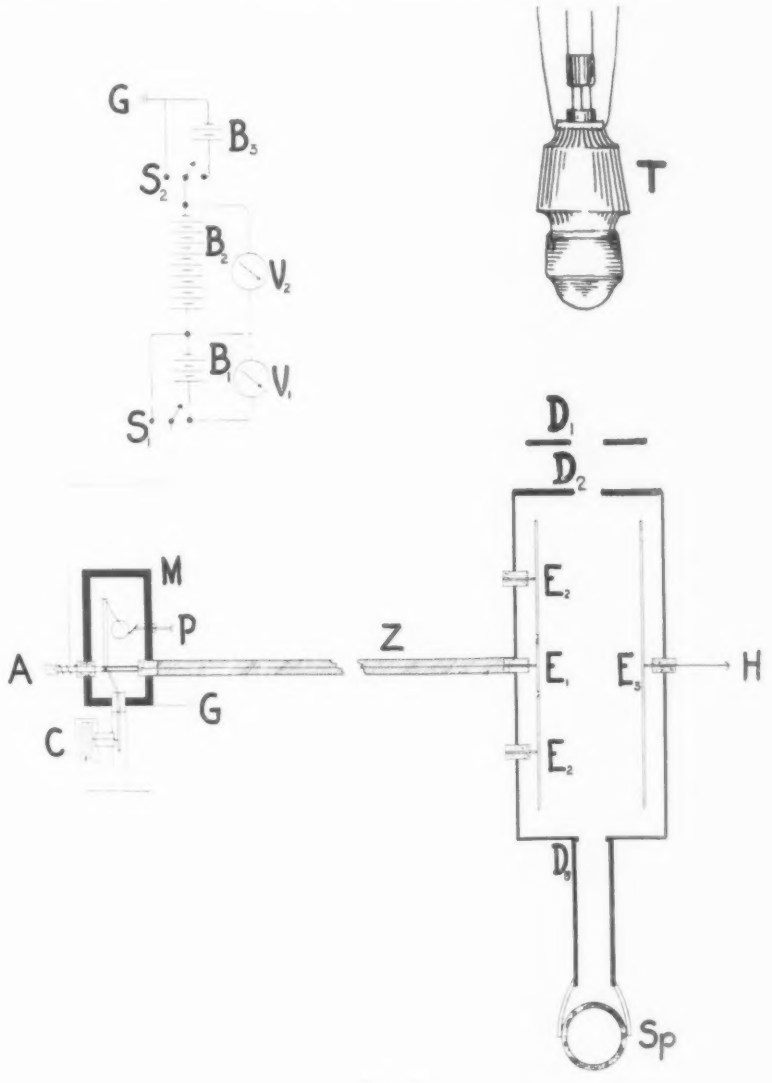


Fig. 8.

relation to the half-value layer in aluminum. Of course these values are only average values, since the composition of tissue may change considerably under different conditions. The data are collected in Table IV and are shown graphically in Figure 7.

The data given in Table IV permit us to calculate the average penetration of grenz rays when the quality of radiation has been determined in half-value layers of aluminum. For instance, if for certain 0.47 mm. of water, in 0.52 mm. of muscle, in 0.56 mm. of epidermis or in 0.77 mm. of subcutaneous tissue.

*Quantity Determinations of Grenz Rays.* The indirect method of measurement of quantity by means of the milliammeter has been found to be unsatisfactory. With decreasing milliamperage the decrease in intensity output is less than it would be proportionately, probably because of an increase in the voltage. It is

therefore advisable to use the same milliamperage in all investigations. It is far better, however, to measure the quantity

FIG. 9.

of radiation by direct measurements at the point of application. We have attempted to calibrate the grenz-ray doses in standard R units, a procedure which is especially desirable since recent comparisons have shown that the R units as determined experimentally in different countries agree very satisfactorily.

TABLE IV

HALF-VALUE LAYER IN ALUMINUM AS COMPARED WITH HALF-VALUE LAYERS IN WATER, MUSCLE, CUTIS VERA, EPIDERMIS AND SUBCUTANEOUS TISSUE

| E.m.f., Kv. | Half-value Layer | | | Half-value Layer | |
|---|---|---|---|---|---|
| | Aluminum, Mm. | Water, Mm. | Muscle, Cutis Vera, Mm. | Epidermis, Mm. | Subcutaneous Tissue, Mm. |
| 4 | 0.007 | 0.12 | 0.13 | 0.14 | 0.20 |
| 5 | 0.0125 | 0.20 | 0.22 | 0.24 | 0.33 |
| 6 | 0.0175 | 0.28 | 0.31 | 0.34 | 0.46 |
| 8 | 0.0250 | 0.39 | 0.43 | 0.47 | 0.64 |
| 10 | 0.0335 | 0.52 | 0.57 | 0.62 | 0.86 |
| 12 | 0.0400 | 0.62 | 0.68 | 0.74 | 1.02 |

We have standardized the grenz-ray doses in R units in exactly the same manner as we standardized the doses of other qualities of radiation. (The method was described in detail in a previous paper.)[4] A diagram of the standardization arrangement for grenz rays is given in Figure 8. Since grenz rays are easily absorbed in air, it is necessary to take special precautions for the determination of the air volume which is irradiated. This is particularly true when a large air chamber is used because of the comparatively large focus of the tube and the focal distance.

On account of these difficulties we believe our measurements to be only within 5 per cent of accuracy, which, however, is quite satisfactory.

Large chambers, on account of the great technical difficulties they present, are not suitable for use in practical therapy and we therefore attempted to find a small ionization chamber for grenz rays which would be as satisfactory as other small chambers which we are using in our research and in roentgen therapy. After investigating a number of materials (celluloid, paper, cellon, etc.) we found goldbeater's skin of 0.01 mm. thickness to be an ideal material for such a small ionization chamber. Small chambers of goldbeater's skin can easily be coated with graphite, which makes them conductive; and they do not show changes due to variation in humidity or temperature. Figure 9 shows a roentgenogram of such a chamber which was made with a Müller tube with 5 kv., 10 ma., 10 cm. distance and one minute exposure. This goldbeater's skin chamber may be connected to any practical roentgen-ray dosimeter. Chambers of this type are now in practical use and have proved to be satisfactory.

To make absolute measurements this small chamber must first be calibrated by means of the large standard air chamber which has been previously mentioned. This standardization of the small chamber showed that the ionization current produced in it is parallel to that in the large air chamber over the range of from 5 to 12 kv.; in other words, the small chamber measured the intensity of radiation within this range independent of the quality of the radiation. At 4 kv. the absorptive qualities of the chamber became evident and it was necessary to make the proper corrections. It is therefore believed that this ionization chamber may be calibrated in R units and that it is satisfactory for practical measurements.

All the absorption measurements described above have been made by means

of this chamber as they were found to be sufficiently accurate because of their independence of the wave lengths within the range mentioned.

*Dosage Measurements in Practice.* We first determined the dosage of grenz rays for the conditions of radiation which are ordinarily used in practice. Using 10 kv. at the tube, 10 ma., 4 cm. window-chamber distance (0.6 focus distance), and a half-value layer for aluminum of 0.0335 mm., we measured an intensity of 396 R per minute with the Müller tube. Under the same mechanical conditions except for 6 kv. at the tube and a half-value layer for aluminum of 0.0175 mm., the intensity was only 47.2 R per minute. If we accept the value of 250 R as the threshold erythema dose for grenz rays, the erythema time under the first conditions would be 38 seconds; and under the latter conditions, 5¼ minutes. An increase of the window-chamber distance from 4 to 20 cm. decreases the intensity of the radiation with 10 kv. from 396 R per minute to 42.5 R per minute (5¼ minutes for erythema time). If, when using 6 kv., the distance is similarly changed from 20 to 4 cm., the radiation intensity decreases from 47.2 R per minute to 3.2 R per minute, and in this case the erythema time would be 78 minutes. This value seems improbable on the basis of our present knowledge. It would seem, therefore, that under these conditions a dose of less than 250 R units would produce an erythema reaction. However, we must follow up these observations more carefully before any final conclusion can be drawn and we hope to report the results of this investigation within a short time.

Further values for the radiation intensities for different distances are given in Table V. A study of this table demonstrates the important decrease which occurs in the radiation intensity with increasing focal distance. The large focus of the tube, the distance itself, as well as the absorption in air effect a decrease of the intensity such as cannot be calculated by any method, as, for example, by the law of inverse squares.

Table VI illustrates the decrease of intensity which takes place with decreasing potential.

These data show the tremendous decrease of the radiation dose with decreasing potential. They show furthermore that for grenz rays it seems almost impossible to find an indirect method of dosage measurement, and that in order to make further progress in grenz-ray therapy, exact dosage measurements seem to be essential. The values given in the tables refer, of course, only to our own special apparatus but they give valuable suggestions as to the influence of distance, potential, and other factors upon the radiation dose. The measurements made directly on the patient or on a phantom and those made in air do not show any difference when identical conditions of irradiation are used, since the backscattering with these oversoft rays is negligible.

Very satisfactory dosage measurements with these rays have also been made by means of the Wintz-Rump roentgen photometer. They will be described elsewhere.

TABLE V

RADIATION INTENSITIES IN R MIN. AND ERYTHEMA TIMES PER DOSE OF 250 R FOR DIFFERENT DISTANCES
Müller tube; 10 ma.

| | 6 Kv. Radiation | | 10 Kv. Radiation | |
|---|---|---|---|---|
| Distance in Cm. (Window Chamber) | R Min. | Erythema Time in Min. for 250 R | R Min. | Erythema Time in Min. for 250 R |
| 4 | 47.2 | 5.3 | 396 | 0.6 |
| 6 | 27.6 | 9.0 | 239 | 1.0 |
| 8 | 18.2 | 13.7 | 162 | 1.5 |
| 10 | 12.7 | 19.7 | 126 | 2.0 |
| 15 | 5.9 | 42.3 | 66.5 | 3.8 |
| 20 | 3.2 | 78.0 | 42.5 | 5.9 |

TABLE VI

RADIATION INTENSITIES AND ERYTHEMA TIMES PER DOSE OF 250 R FOR DIFFERENT POTENTIALS
Müller tube; 10 ma.

| | 20 Cm. Distance Window Chamber | | 4 Cm. Distance Window Chamber | |
|---|---|---|---|---|
| E.m.f., Kv. | R/Min. | Erythema Time in Min. for 250 R | R/Min. | Erythema Time in Min. for 250 R |
| 5 | 0.54 | 463.0 | 10.5 | 23.8 |
| 6 | 3.2 | 78.0 | 47.2 | 5.3 |
| 8 | 16.8 | 14.9 | 195.0 | 1.3 |
| 10 | 42.5 | 5.9 | 396.0 | 0.6 |
| 12 | 98.5 | 2.5 | 710.0 | 0.35 |

## SUMMARY

The spectral distribution of grenz rays, i.e., soft roentgen rays with average wave

lengths of from 1 to 3 Å, produced in a lithium glass tube at a voltage of from 4 to 10 kv. is discussed.

This grenz radiation is so soft that it is absorbed to a large degree in air. For this reason only direct determinations of the radiation quality and quantity at the site of application are found to be satisfactory.

The absorption of the grenz rays in aluminum foil of 0.0125 mm. thickness is determined for different conditions of radiation. From the absorption data the half-value layers of grenz rays are determined as lying between 0.00⁷ and 0.04 mm. of aluminum.

Data are given to translate the half-value layers of aluminum into half-value layers of air, water, muscle, cutis vera, epidermis and subcutaneous tissue.

The method of standardizing the intensity of grenz rays in R units per minute is discussed.

For practical dosage measurements of grenz rays a small (1 c.c.) ionization chamber of goldbeater's skin is described, which can be connected to any ionization roentgen dosimeter. It measures the radiation intensity of grenz rays independent of the wave length down to 4 kv. and shows no appreciable absorption.

With this chamber data for the intensity of grenz rays in R/min. have been determined for a number of conditions and found to vary between ca. 400 R/min. (at 10 kv., 10 ma., 4 cm. distance) and 0.5 R/min. (at 5 kv., 10 ma. and 20 cm. distance).

The threshold erythema dose for grenz rays seems to be in the neighborhood of 250 R units.*

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* We wish to express our appreciation of the assistance of Mr. I. E. Beasley, who made a large number of the measurements.

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# THE EFFECT OF IRRADIATION ON THE SUPRARENAL GLAND*

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WHENEVER a patient, who has been exposed to roentgen or radium rays for any pathologic condition, develops some complication the cause of which is not obvious, the attending physician or surgeon is prone to attribute it forthwith to irradiation, although there can often be no possible connection. The path of least resistance is such a well-beaten road and so easy to follow! As an example of direct interest to the radiologist I should like to cite the suprarenal gland. It has been claimed that this gland is rather sensitive to irradiation and that its exposure to roentgen rays may lead to serious disturbance. Indeed, a number of cases have been reported as instances of the injurious effect of radiation on this structure. A critical review of the experimental and clinical evidence bearing on this question may, therefore, be worth while.

The attention of the medical profession was first attracted to the subject of the action of irradiation on the suprarenal gland by Golubinin's report (1905) of a case of Addison's disease, apparently due to tuberculous infection of the suprarenals, in which, after fifty exposures in sixty days to small roentgen-ray doses, striking improvement occurred. The beneficial effect of moderate doses of roentgen rays on certain forms or stages of tuberculosis is well known. Wetterer (1908) also reported and attributed to Wiesner a case of supposed Addison's disease, in which improvement is said to have followed roentgen-ray treatment, but the data in this report are inconclusive.

Animal experiments have been conducted by several investigators in an effort to determine the action of roentgen rays on the normal suprarenal gland.

Harvey (1908) exposed the abdomen of two guinea pigs (one male and one female) and two female rabbits to from 1 to 8 Sabouraud doses of soft roentgen rays (3.5 to 4 inch spark gap). The guinea pigs were killed with chloroform six and ten hours afterward, and the rabbits after eighteen and sixteen days, respectively. The organs of several normal animals were fixed and stained in the same way as those from the irradiated animals to serve as a basis for comparison. Clumps of altered blood corpuscles scattered throughout the sections were noted by Harvey, who assumed them to indicate either congestion or hemorrhage and attributed them to the irradiation, because he did not find similar changes in the organs of normal animals. This report is brief and rather casual.

Cottenot, Mulon and Zimmern (1912) exposed the suprarenals of one dog (without controls) to from 12 H to 16 H units of hard roentgen rays (these would now be considered rays of medium quality, although details are not given) for six consecutive days, the two glands being irradiated alternately. Necropsy was not performed until several hours after death. These authors describe the changes observed in the glomerular zone of the cortex as consisting essentially in hypertrophy of the cells, a tendency to change in shape from cylindrical to polyhedral; a rounded nucleus and a tendency of the nucleolus to assume the appearance of that in the cells of the fasciculate zone; the resemblance of the cells in the glomerular zone to those normally in the fasciculate and reticulate zones; a tendency of the mitochondria to diminish or to coalesce; no evidence of cell destruction in the glomerular zone, but marked cellular

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

disintegration in the fasciculate and reticular zones. Changes in the medulla and in other organs were not mentioned.

Von Decastello (1912) reported atrophy of the suprarenal glands and hemorrhage in the cortex and medulla in mice, but no atrophy, only hemorrhage, in guinea pigs. The animals were treated from one to two hours on one or more days (short focal skin distance; dose up to 5 Sabouraud-Noiré) and killed within from three to eleven days (number of animals, dosage, controls, and so forth, not stated).

Eisler and Hirsch (1913) brought about the death of rats (number not stated) by exposing the whole body to doses of from 150–200 X (Kienböck) within from eight to ten days (quality of rays not specified). The suprarenal glands of the irradiated animals were removed aseptically and ground up in salt solution; an extract of definite concentration was thus obtained. They prepared a similar extract from sound unirradiated animals. The effect of roentgen rays on the suprarenal glands was tested by injecting into the isolated jugular vein of rabbits the suprarenal extract obtained from irradiated rats, or the extract from normal unirradiated rats, and the effect on the blood pressure was observed directly on the isolated carotid artery. In 4 instances the injection of the suprarenal extract from irradiated rats caused a definite increase in blood pressure, which, however, rapidly returned to normal. With the injection of normal extract the rise in blood pressure was similar, but the increased pressure continued for some time. In 5 other animals the results were negative, a circumstance which Eisler and Hirsch explain on the basis of the time elapsing between death and the preparation of the extract.

Grabfield and Squier (1921) tested the action of roentgen rays generated at moderate voltage (about 125 peak kilovolts; Kingery saturation) on 16 intact rabbits, the animals being kept thus saturated for a week or a week and a half. They were protected from the rays, except in the region corresponding to the suprarenal glands. Some of the animals died, in some instances apparently from intestinal disturbances; the others were killed by a blow on the head. An increase in the weight of the glands and degenerative changes in the cortex were noted, principally nuclear pycnosis, vacuolization of cellular protoplasm, loss of staining quality, and necrosis. No controls were employed. The majority of the surviving animals manifested no abnormal symptoms before they were killed.

According to Strauss (1921) the irradiated suprarenals of guinea pigs and white mice (number not stated) showed tiny red spots on the surface (petechial hemorrhages), a tendency of the capsule to adhere to the liver, and microscopically hyperemia and hemorrhage in the cortex. Degenerative changes in protoplasm and nuclei were not observed, and loss of staining power was found only after large doses had been used. However, Strauss was unable to confirm the atrophy observed by von Decastello (20, 40, 60, 80 and 100 per cent H. E. D. of unfiltered rays, quality not stated).

Holfelder and Peiper (1923) irradiated the localized suprarenals of guinea pigs (42 cm. spark gap: 2 ma.; 0.5 mm. copper filter; 30 cm. focal skin distance; dose below intestinal tolerance) with doses varying between 80 and 160 per cent H. E. D. at the surface. One animal which received 160 per cent H. E. D. to each of two fields cross-firing the suprarenal region died in four days. No macroscopic or microscopic changes were found in the skin, suprarenal glands or intestine. Of the remaining 5 animals 3 increased in weight following the irradiation, and one was in good condition when killed; none of these 4 showed any ill effects. The remaining animal had received 160 per cent H. E. D. (single posterior field) and had lost 40 gm. in weight.

The histopathologic alterations varied greatly from animal to animal, and there did not seem to be any relation between them and the dosage. The glomerular zone generally remained unchanged. In the fasciculate zone the changes varied greatly. Slight vacuolization of the protoplasm, lobulation and irregularity in shape and staining power of the nuclei, and diminished lipoid content were noted in all the surviving animals. There were many small

hemorrhages in both the fasciculate and reticulate zones. In one case this hemorrhagic tendency gave the cortex a bloody appearance. The cell outlines were often indistinct; there was irregular distribution in the reticular pigment. No changes were observed in the medullary substance.

David and Hirsch (1923), on the basis of irradiation of the isolated suprarenal glands of 40 animals, reported a decrease in the production of epinephrin under 1 H. E. D. and an increase under 0.25 H. E. D., from which they deduce that small doses stimulate, while large doses inhibit, the production of epinephrin.

Martin, Rogers and Fisher (1924) first operated on 4 large dogs and removed the right suprarenal gland through an incision in the loin. None of the animals showed any ill effects from this procedure. After the incision had healed, a second incision was made in the upper left portion of the abdomen of each dog, under ether anesthesia, and the stomach and intestine were held away from the left suprarenal gland by special wire retractors covered with moist, sterile gauze. The lower end of a special cone 2 inches in diameter was made to encircle the suprarenal and to press firmly against the muscles of the back. This field included the upper pole of the left kidney. A dose of 75 ma-min. of unfiltered roentgen rays was then given. The voltage was equivalent to a 5 inch parallel spark gap; the focal skin distance, 10 inches; the intensity of current, 10 ma. This dose is sufficient to produce cachexia and death when applied, in the dog, to an isolated loop of small intestine.

One animal died from peritonitis four days after the second operation. On the 3 remaining dogs the second operation, with irradiation, was done thirteen, nineteen and twelve days respectively after the first operation (removal of the right suprarenal). The 3 dogs recovered without incident, remained in excellent condition and gained steadily in weight until they were dispatched twenty-six, seventy-eight, and ninety-eight days respectively after irradiation. Necropsy was performed on only 2 of these 3 animals.

The left suprarenal gland of the dog killed twenty-six days after exposure to roentgen rays was almost white in color, somewhat shrunken, firm in consistence, and suggested a lymph node rather than the suprarenal. Microscopic examination showed an extensive replacement of the normal structure by fibrous tissue. Many endothelial cells and fibroblasts were noted in some areas and dense masses of collagen fibrils, with relatively few nucleated cells, in other areas. Small islands of normal adrenal cortex were scattered through the scar tissue. No evidence of medullary tissue was found. On the contrary, the left suprarenal of the dog killed ninety-eight days after irradiation was quite normal.

Tsuzuki (1926) exposed the entire body of rabbits to varying doses for fifteen, thirty, forty-five, sixty, and one hundred twenty minutes, representing respectively 10, 20, 30 and 40 per cent H. E. D. of hard roentgen rays (170 peak kilovolts; 2 ma.; filtered through 0.5 mm. copper and 1.0 mm. aluminum; spark gap, 25 cm.; average wave length, 0.14 A; absorption coefficient, $\mu = 0.164$). In one experiment these doses were given at one session, and the animals were kept under observation until they died, or as long as fifty-six days if they survived. In a second experiment the rabbits were exposed to similar doses and killed at intervals of from fifteen minutes to ninety-six hours, and in the third experiment the animals were irradiated continuously until they died. In all cases in which death occurred, complete necropsy was performed and the gross and microscopic changes were recorded. The suprarenal effects noted by Tsuzuki under these conditions were: reduction of fat content in the cortex, degeneration of medullary cells, and after extreme doses, atrophy of the medulla.

Wislocki and Crowe (1922), incidental to their study of the accessory chromaffin system, combined surgical excision and destruction by radium of the remainder of the suprarenal glands; but, except to prove that radium emanation implanted in the suprarenal glands causes organic disintegration, their experiments have no bearing on radiologico-biologic relationships. The same may be said of the experiments of Lacassagne and Samssonow who,

by causing more or less complete destruction of the suprarenal gland by means of radium emanation, showed the apparent indispensability of the suprarenal cortex to life.

Variation in the experimental results is not necessarily contradictory and may merely reflect the wide variation in the experimental conditions, which, in most cases, have not been stated. Moreover, the results of most of the experiments are vitiated by the small number of animals used and the lack of adequate controls. In view of the known histologic variations in normal animals, it is not clear how much of the alterations is really attributable to the action of the rays and how much to factors independent of them, such as, for example, the hypertrophy of the adrenal cortex and general hyperemia of the gland incidental to rut in the male and to pregnancy in the female. For these reasons, therefore, it is difficult to estimate the precise relationship to roentgen-ray exposure of the hyperemia and hemorrhage recorded by Harvey, von Decastello, Strauss, and Holfelder and Peiper. The apparent tendency toward congestion and hemorrhage may be a direct effect of the irradiation, but it may also be an indirect expression of action on other structures, such as the small intestine, since in most cases no attempt was made to limit irradiation to the suprarenals. Nor is it less difficult to reconcile the atrophy observed by von Decastello in mice with his failure to note similar atrophy in guinea pigs; especially if we also consider Strauss' inability to confirm such atrophy either in mice or guinea pigs, and the report, by Grabfield and Squier, of increased weight of the suprarenal glands. Unfortunately, Grabfield and Squier fail to account for this increase in weight.

More or less extensive evidence of degenerative changes is reported and described by Cottenot, Mulon and Zimmern, Grabfield and Squier, Martin, Rogers and Fisher, and also by Holfelder and Peiper. In the case of Cottenot, Mulon and Zimmern, several hours had elapsed between death and necropsy, a circumstance which must be considered in connection with the histologic appearances they describe. The descriptions of Grabfield and Squier, and of Holfelder and Peiper seem to confirm essentially that of Cottenot, Mulon and Zimmern, while that of Martin, Rogers and Fisher, who record replacement by connective tissue, indicates a much older process. Strauss, on the other hand, failed to observe degenerative alterations. The explanation for this apparent difference may lie in the difference in dosage or in the period of observation, but the available information is not sufficient to settle this point.

The marked fibrous change and absence of medullary substance noted by Martin, Rogers and Fisher in one of two animals which came to necropsy indicates that a strong dose of roentgen rays may cause severe injury to the suprarenal gland, but the failure of a similar dose to affect this gland in the second animal is difficult to explain, unless the organ slipped out of the field of irradiation. There is no doubt that roentgen rays can cause degeneration of this as of other organs if the dose is sufficiently strong. The doses used in most of the experiments cited were distinctly greater than those employed in treating human beings; nevertheless, the pathologic effects described are far from uniform and conclusive. It is important to note that the degenerative changes described have concerned the cortical much more than the medullary portion of the gland. Especially noteworthy is the inability of Holfelder and Peiper and others to find any medullary disturbance regardless of dosage. The contention of David and Hirsch that small doses of roentgen rays increase, while large doses decrease, the production of epinephrin, lacks confirmation.

In several records, those of Grabfield and Squier, Martin, Rogers and Fisher, and in most of these of Holfelder and Peiper, specific mention is made that, in spite of the histopathologic alterations noted, there was no corresponding deterioration in the health of the animals. This is significant in connection with the contention of Holfelder and Peiper, whose emphasis on the great danger of suprarenal irradiation is based on a direct relationship

between the cellular disturbances thus produced and clinical manifestations of impaired health which did not occur in the majority of their animals.

The experiments of Eisler and Hirsch, and of Tsuzuki must be considered separately, because the whole body of the animal was exposed. This introduces many complicating factors, such as possible effects on blood, bone marrow, intestines, and other organs. Moreover, in the experiments of the former, as well as in some of the latter, the animals were exposed to enormous (fatal) doses of roentgen rays. Therefore, whatever significance and value such experiments may have in certain respects, the results must be interpreted by themselves and cannot be compared with the results of therapeutic doses in man. One point in the experiments of Tsuzuki deserves attention. His constant finding of "reduction of fat in the cortex and degeneration of medullary cells" (except under extreme doses when atrophy of the medulla occurred) suggests a secondary rather than a primary and direct action of the rays on the suprarenal glands.

Starting from the premise based on the unconfirmed work of Vaquez, and of Josué, that increased blood pressure and certain vascular phenomena responsible for or commonly associated with it are the result of hyperplasia of the suprarenal gland and of increased function incident thereto, Zimmern and Cottenot (1912) presented a series of cases tending to show that irradiation of the suprarenal region is followed by a more or less rapid drop in systolic pressure varying between 20 and 80 mm. of mercury, lasting from several weeks to several months, and accompanied by improvement in subjective symptoms. In only one of 16 patients so treated (relatively small dose of roentgen rays) did the systolic pressure fail to diminish. Similar results were obtained by Quadrone (1913) in 4 cases; in 2 there was also a disappearance of circulating epinephrin estimated by the Ehrmann method. Diminution in systolic blood pressure and symptomatic improvement in 12 cases following roentgen-ray irradiation of the suprarenal region has likewise been reported by Sergent and Cottenot (1914).

On the other hand, much doubt has been cast on the results of the foregoing clinical studies by those of Groedel, Weinstein, Levy-Dorn and Weinstein, and Desjardins and Marquis, who not only failed to obtain uniform and substantial diminution in blood pressure by roentgen rays directed to the suprarenals, but questioned the results of, and the explanations advanced by, Zimmern and Cottenot, Cottenot, Sergent and Cottenot, and Quadrone. Groedel was unable to bring about in this manner a diminution in the blood pressure of 2 patients suffering from hypertension. Weinstein, who tested the effect of irradiation on supposedly healthy suprarenal glands, reported that slight and transitory increase in blood pressure occurred in one-third of the cases so treated. Levy-Dorn and Weinstein exposed the suprarenal region and surrounding territory of 10 patients with apparently normal glands to an erythema dose of roentgen rays (quality uncertain), but no constant effect was noted. The blood pressure remained stationary in some, while it increased or decreased slightly in others. Stephan has expressed himself in the same sense. The results obtained by Desjardins and Marquis with high voltage roentgen rays (200 peak kv.; filter: copper 0.5 mm., aluminum 1.0 mm.; distance, 60 cm.; 5 ma.; time, 75 to 90 minutes) in 55 cases, in which the suprarenal glands were apparently normal, treated through this region for various other conditions, such as carcinoma of the stomach or pancreas, hypernephroma, and lymphoblastoma, agree with those of Levy-Dorn and Weinstein. Such variations in blood pressure as were noted could be readily explained by factors other than the effects of roentgen rays on the suprarenal glands.

It is true that the action of roentgen rays on the normal suprarenal gland may not necessarily be the same as on the diseased gland, but, on the other hand, a cause-and-effect relationship between hypertension and hyperplasia and hyperfunction of the suprarenal gland has never been established. Consequently, the mere possibility that roentgen rays may, under certain conditions, produce degenerative

cellular alterations in these organs, does not prove that diminution in blood pressure following roentgenization of the suprarenal glands is necessarily the result of such organic changes. This is further shown by Levy-Dorn and Weinstein and also by Desjardins and Marquis, who observed no greater variations in blood pressure when the suprarenal region was irradiated than when irradiation was directed to remote parts. Epinephrin, which is the only principle of the suprarenal gland known to affect blood pressure, is chiefly a product of the medullary portion of the suprarenal gland; therefore, since the changes reported and attributed to irradiation have concerned the cortex much more than the medullary substance of the gland, it is not clear how such cortical alterations could have any influence on blood pressure. There is some evidence that the cortex also is a factor in the production of epinephrin, but there can be no question that most of it is elaborated in and by the medulla.

Influenced by the work of Zimmern and Cottenot and of von Decastello, Dresel (1920) and Beumer (1921) attempted to influence blood sugar in diabetes by irradiating the suprarenal glands, on the assumption that epinephrin, and therefore suprarenal function, has a direct influence on sugar economy, and that injection of epinephrin is followed by hyperglycemia and glycosuria. Therefore, if suprarenal function could be depressed by roentgen rays the glycemia and glycosuria in diabetes should be diminished. However, the case histories offered to support their contention (Dresel 3 and Beumer 1) are not impressive, and their work has not been confirmed.

Five cases have been reported (2 by Holfelder, and one each by Arrillaga and Izzo, Smithies, and Tuffier) which suggest that irradiation may cause acute suprarenal insufficiency and sometimes lead to Addison's disease. The inference has been drawn that irradiation of the suprarenal glands is dangerous and to be avoided. Indeed, Holfelder has strongly emphasized this danger, partly on the basis of his experiments on animals and partly on the strength of his observations in two human beings.

One of the two patients was a man, aged fifty-four, suffering from inoperable carcinoma of the rectum with many metastatic nodules in the liver. Three or four weeks after the exploratory laparotomy, roentgen-ray treatment had been directed to the primary tumor, and two weeks later through the upper abdomen also (110 per cent H. E. D. to each of three fields in the upper abdomen at one sitting). Three days later extreme weakness and depression developed, followed shortly by bronzing of the skin, which persisted one month and gradually diminished as the subjective symptoms improved.

The other patient was a school teacher, also aged fifty-four, suffering from cystic carcinoma of the pancreas. She was operated on in 1918 and roentgen rays applied postoperatively. She returned in 1920 with symptoms suggestive of recurrence. At a single sitting she was given 90 per cent H. E. D. through each of three fields, all focused on the pancreas. Soon afterward extreme weakness, depression and bronzing of the skin developed, but these symptoms gradually subsided.

In the case recorded by Smithies, strong irradiation had been used for carcinoma of the stomach which, Smithies claims, did not exist. Acute manifestations of Addison's disease developed soon afterward and the patient died, the death being attributed to insufficiency of the suprarenal glands induced by irradiation.

The case recorded by Arrillaga and Izzo concerned a patient with Addison's disease who also had an epithelioma of the tonsil. High voltage roentgen-ray treatment was directed to the tumor for a session of forty-two minutes. The next day the patient became excited and his temperature rose to 38.5°C. He fell into coma twenty-four hours later but emerged from this quickly following an injection of 0.001 gram of epinephrin. The epinephrin was continued until the following day; when it was stopped the patient soon became comatose again. An injection of epinephrin again restored him, but he was extremely weak and died the next day.

Tuffier's patient, who had undergone amputation of the breast for carcinoma in November, 1919, experienced severe sciatic pain in September, 1920. This was thought to be due to metastasis to the spine or to the prevertebral lymph nodes, and she had received roentgen-ray treatment through the dorsolumbar region several times between 1920 and 1923. Each course of treatment was followed by distinct relief from pain, and by general improvement. About two weeks after the last course in February, 1923, severe and uncontrollable vomiting occurred. Food was not tolerated and medication had no effect. The vomitus was black, and microscopic examination disclosed much blood. The symptoms continued until April 25, when an injection of epinephrin suddenly and miraculously stopped the vomiting, and it did not recur. The patient improved steadily thereafter.

Metastatic invasion of, or primary extension to, the suprarenal glands is not a particularly rare complication of carcinoma in some other organ, a complication which has not been excluded in any of the cases mentioned. In Smithies' case necropsy was not performed; consequently, the presence or absence of a malignant growth was not definitely established. The circumstances in the case of Arrillaga and Izzo are unusual and cannot be explained easily; it is probable that irradiation served to precipitate a crisis in the already established Addison syndrome, but it is not clear what the mechanism may have been. Certainly a direct effect of irradiation on the suprarenal gland cannot be considered, because irradiation had been limited to the tumor in the tonsil. Tuffier's case is interesting, but it does not prove that the patient's symptoms were due to changes in the suprarenal glands caused by irradiation. If such a factor had been operating it is likely that the symptoms would have recurred as soon as the effect of the single injection of epinephrin had ceased. The sudden onset of bloody vomiting, and its sudden cessation two months later, after a single injection of epinephrin, cannot be accounted for on such a basis. Moreover, the subsequent improvement in this case, and similar improvement in Holfelder's cases may possibly have been the result of inhibition of the malignant process by the roentgen rays.

If we consider the large number of patients subjected to irradiation in which the suprarenal glands receive doses as large as other structures without showing untoward effects, the natural and justifiable conclusion is that the 5 cases alluded to are probably examples of metastasis or primary extension of a malignant growth to the suprarenal glands and of coincident insufficiency. Desjardins and Marquis, who studied this question in 55 patients with normal suprarenal glands subjected to high voltage roentgen rays, failed to observe any clinical manifestations of suprarenal insufficiency. I have never seen an instance of it. Consequently, it is doubtful if the histologic alterations described by Holfelder and Peiper as effects of irradiation of the suprarenal glands have any bearing on, or serve to explain, the rare occurrence of suprarenal insufficiency in man under irradiation; it is much more likely that such insufficiency is due to coincident metastatic invasion of, or primary malignant extension to, the glands. Although the possibility that the symptoms described may have been induced indirectly cannot be dismissed altogether, the relationship between such symptoms and the inconstant alterations in cellular structure which have been observed under experimental conditions has not been clearly established. The fact that such cellular disturbances have involved mainly the cortex, as shown by Holfelder and Peiper, is well-nigh decisive, if we remember that epinephrin is largely a product of the medullary and not of the cortical cells.

## CONCLUSIONS

Much of the experimental work bearing on the biologic action of irradiation of the suprarenal glands is of doubtful value, because it has often been based on unfounded assumptions, and many of the records of such experiments are full of unwarranted deductions. The animal experiments show that roentgen rays may cause pathologic changes in the suprarenal gland, but strong doses—doses well beyond the therapeutic range for human beings—must be used to induce such changes. The

pathologic alterations affect chiefly the cortical portion of the gland; medullary changes also may occur, but this portion of the organ is distinctly less susceptible to irradiation than the cortex. In spite of the morphologic disturbances in the suprarenal produced by irradiation under experimental conditions, the health of the animals was not deleteriously influenced. Therefore, since the suprarenal factor influencing blood pressure is chiefly a product of the medullary cells, the ground for the contention that irradiation can diminish blood pressure in hypertension is not solid. The same consideration makes it difficult to accept the idea of Dresel, and Beumer, that irradiation of the suprarenal glands can diminish the blood sugar of diabetic patients, and that of Holfelder and Peiper, and others, that the acute suprarenal insufficiency manifested by 5 patients following irradiation could be attributed to pathologic alterations in the suprarenal glands induced by such irradiation. There does not appear to be much basis for the contention that the suprarenal gland is particularly sensitive to irradiation, more so even than the small intestine. The evidence points clearly in the opposite direction.

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# THE STANDARD IONIZATION CHAMBER FOR ROENTGEN-RAY DOSAGE MEASUREMENTS*

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THE unit of roentgen-ray dosage and the method of measuring roentgen-ray dosage used in the research reported in this paper are substantially those employed for the last fifteen years in the hospital and laboratories of the Harvard Cancer Commission. They have been described briefly in previous papers published in the American Journal of Roentgenology and Radium Therapy.[1,2,3] The unit roentgen-ray beam may be defined as that which produces a saturated ionization current of one electrostatic unit per cubic centimeter of the air under standard conditions of temperature and pressure. In making a measurement, care must be taken (*a*) that the measuring instrument measures all the ionization produced by the photo-electrons and recoil electrons coming from the molecules of the air, and (*b*) that secondary radiation from the walls of the instrument, etc., produces no appreciable effect. If the strength of a roentgen-ray beam is measured in terms of this unit, the total dose of radiation delivered by the beam is obtained by multiplying the strength of the beam by the number of seconds of time in the exposure. The total dose is then expressed in electrostatic (E) units, which are the same as the R units, defined and used extensively in Germany. Owing to the fact that, in general, the biological effect of a given roentgen-ray dose is not independent of the length of time during which it is delivered, one must bear in mind that two quantities should be measured and stated in any given case. These may be the strength of the beam and the total dose, or the strength of the beam and the time of exposure, or the total dose and the time of exposure. If the total dose is expressed in E or R units, the strength of the beam may be expressed in E units per second or R units per second, or else in e units or r units. The time of exposure should be expressed in seconds.

The standard ionization chamber for measuring the roentgen-ray beam in terms of the above unit is an open-air chamber. It consists of two parallel plates charged to a certain difference of potential, a small portion of one of the plates being joined to a galvanometer, which measures the ionization current. The object of the research described in this paper has been to determine with greater accuracy than before what the size and dimensions, etc., of the apparatus must be in order that the current produced by the roentgen radiation absorbed in a definite number of cubic

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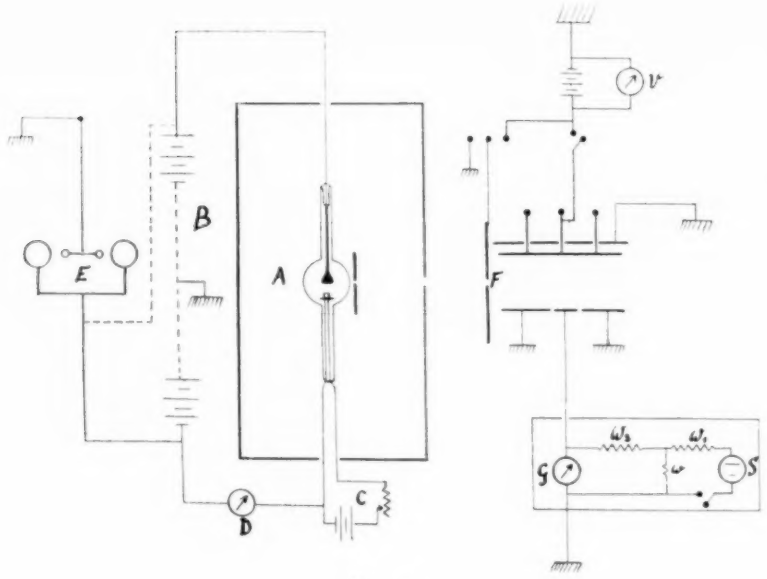


FIG. 1a.

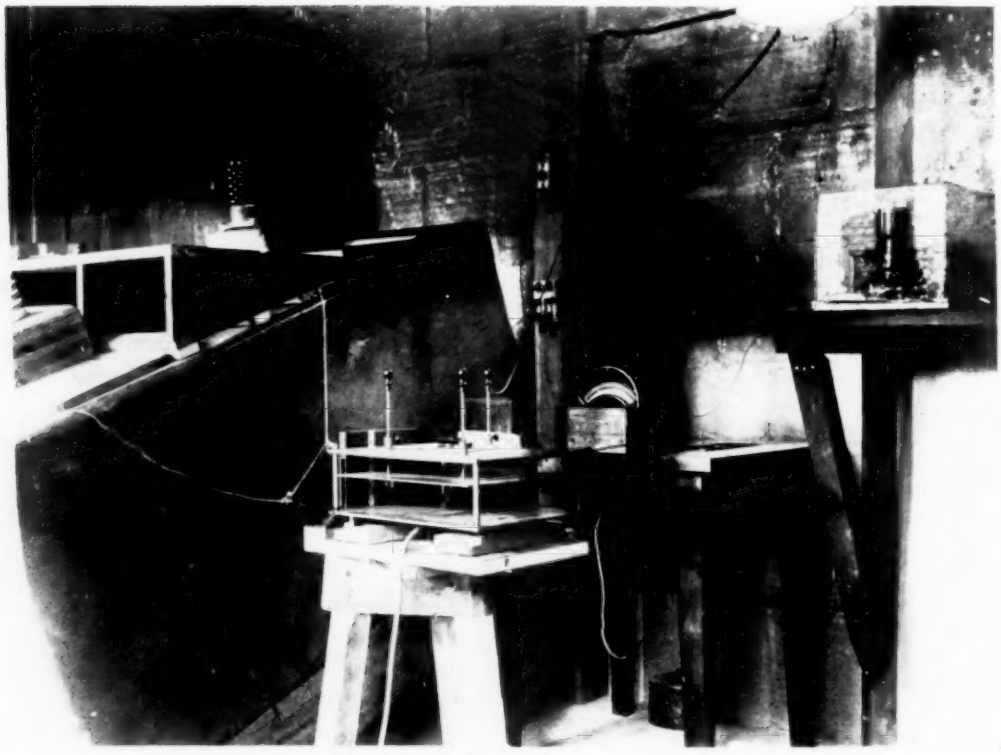

FIG. 1b.

centimeters of the air might be measured by the galvanometer. In particular, we wish to find out: (*a*) just how far apart the parallel plates must be in order that all of the ionization due to the photo-electrons and recoil electrons emitted from the molecules of the air under the influence of the roentgen rays might be included in the

ionization current measured; (*b*) what the dimensions of the plates must be in order that charges on bodies external to the ionization chamber might not change the direction of the lines of force from one plate to another sufficiently to produce an error in the measurement of the ionization, and (*c*) whether the material composing the plates might not have an influence on the measurements.

The diagram (Fig. 1*a*) and the photograph (Fig. 1*b*) represent the arrangement of the roentgen-ray tube, standard chamber and electrical circuits. A lead box with walls 9 mm. thick completely surrounds the roentgen tube, A, except for two openings for the electrical circuits and one opening to permit the passage of a roentgen-ray beam. A high tension storage battery, B, delivers current to the tube at any desired difference of potential up to about 100,000 volts. The current in the circuit, C, heats the Coolidge cathode of the tube, and the milliammeter, D, measures the current passing through the tube. The center of the storage battery is joined to earth and the potential at either the positive or the negative terminal can be measured by an electrostatic voltmeter, E. This voltmeter is calibrated by measuring the current coming from the storage battery and passing through a manganin wire resistance of 6,038,000 ohms which is not represented in the figure. A sharply defined beam of roentgen rays is obtained by using the radiation coming from the target of the tube in a direction making a small angle with its surface and passing through several openings in thick sheets of lead as represented in Figure 1*a*. The third opening, F, defines the cross section of the beam of rays which enters the ionization chamber. The dimensions of this opening are 5 cm. in the direction normal to the diagram and 0.5 cm. in the direction lying in the plane of the diagram. The sides of the opening are bevelled so that the roentgen rays do not strike them and, therefore, do not produce secondary radiation that can enter the ionization chamber. A small battery, with a voltmeter, V, to measure its electromotive force, charges the upper of the two parallel plates to a known potential. The lower plate consists of two sections,

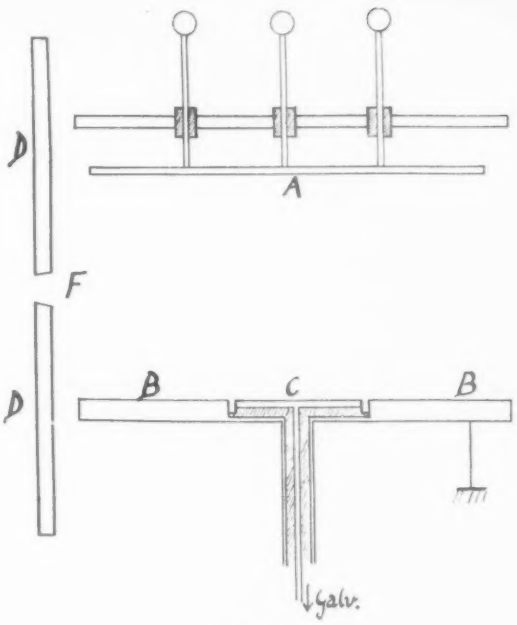


FIG. 2.

one of them put to earth and the other joined to the galvanometer, as represented. The second section has a width of 5 cm. measured to the mid-points of the spaces between the sections, and a length of 18.1 cm. perpendicular to the diagram. Before and after each series of measurements, the galvanometer, G, is calibrated by means of the standard cell, S, with an electromotive force, E, and the carefully measured resistances, W, $W_1$ and $W_2$. The values of these electrical constants are E = 1.0194 volts, W = 6.164$^7$, $W_1$ = $^7$4,026, $W_2$ = 50,415, galvanometer resistance = 800 ohms. With this arrangement of resistances, a current of 4.99$^7$ electrostatic units passes through the galvanometer on closing the key of the circuit. As the deflections of the galvanometer usually amount to 10 or 20 cm. with a scale distance of 4 meters, this method of measuring ionization currents appears to be accurate, the errors of measurement not exceeding a few tenths of a per cent.

Figure 2 represents the construction of the standard ionization chamber in greater detail. The upper plate, A, about 35 × 35 cm. and supported by three rods, may be placed at any desired distance from the lower one, which has the same dimensions.

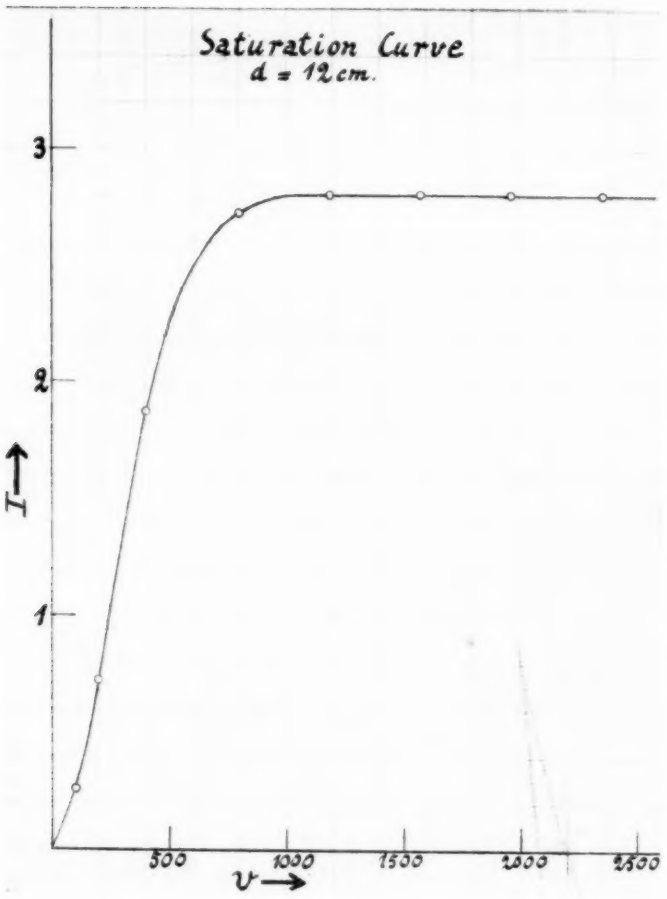


Fig. 3.

Part of the lower plate, B, is joined to earth. The central section of it, C, however, is carefully insulated from the rest and joined to the galvanometer. The wire joining it to the galvanometer passes through a highly insulating material surrounded by a flexible metal tube joined to earth. The metal shielding of the galvanometer circuit is of extreme importance. The galvanometer itself and all of the resistances used in its calibration are enclosed in a metal casing joined to earth. This metal shielding is necessary in order to prevent stray currents from reaching the galvanometer. The lead plate, D, with the hole in it, F, which defines the cross section of the roentgen-ray beam, is insulated from the rest of the apparatus and may be charged either to the potential of the upper plate or put to earth. This arrangement has been adopted in order to investigate the possible influence of the charge of the lead plate on the direction of the lines of force in the electrical field between the plates. If the lead plate is charged to the potential of the upper plate, it tends to push the lines of force running from the upper plate to the lower plate away from it; but, if the lead plate is put to earth, it tends to draw the lines of force toward it. As will be seen later, this influence produces an error in the measurement, if the distance between the two parallel plates exceeds a certain value.

In all accurate measurements of ionization currents, one must be sure that the difference of potential between the conductors is sufficient to produce practically complete saturation. This point has been tested in our measurements by placing the two parallel plates as far as possible

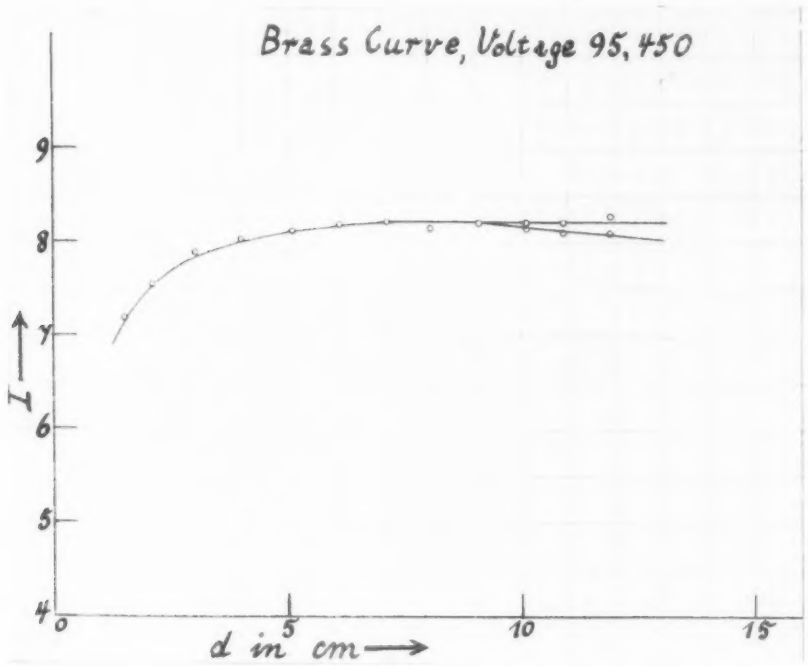


FIG. 4.

away from each other, namely, at a distance of 12 cm. and then reading the deflection of the galvanometer with different numbers of cells in the battery, G (Fig. 1*a*), which charges the upper plate. Figure 3 represents the saturation current curve obtained from the measurements. It appears that saturation is obtained at any voltage above 1200. In the experiments to be described below, we used from 2,000 to 2,400 volts, thus insuring saturation.

The first point that we attempted to decide was the question as to how far the two parallel plates must be apart in order to include practically all of the ionization due to the photo-electrons and recoil electrons emitted from the gas molecules. In order to investigate this point, we placed the plates at different distances, d, apart and adjusted their height so that the roentgen-ray beam passed exactly half way between them, and then measured the ionization current. This was done first with plates of brass and with a voltage of 95,450 applied to the roentgen-ray tube and sheets of aluminum 2 mm. thick placed in the path of the roentgen-ray beam as a filter. In order to investigate the influence of the lead sheet, D (Fig. 2), on the ionization chamber, we took readings at each distance with this sheet charged to the potential of the upper plate and then charged to the potential of the lower plate. The curves in Figure 4 represent the results obtained. It appears that as the distance between the plates is increased from d = 1.5 cm., the ionization current increases in magnitude until the distance between the plates amounts to 6 or 7 cm. From this distance up to between 9 and 10 cm. the curve remains horizontal, but beyond 9 cm. the curve breaks into two sections. The upper section represents the ionization current when the lead sheet, D, was charged to the potential of the upper plate, and the lower section represents the ionization currents when the lead sheet was connected to earth. It appears, therefore, that, if the distance, d, between the plates exceeds about 9 cm., the charging of the lead sheet has an influence on the ionization current and produces errors of the order of about 1 per cent in the measurement. This influence of the lead sheet becomes inappreciable when the distance between the plates is a little

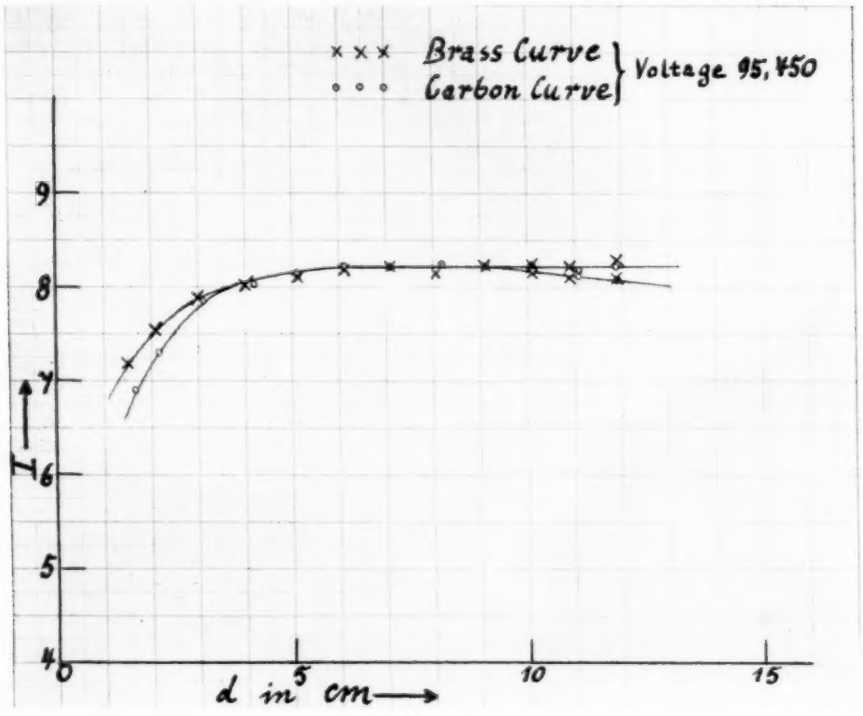


FIG. 5.

over half the distance from the electrode in the standard ionization chamber to the end of the lower plate.

We have tried experiments similar to the above to investigate the possible influence of plates at the *sides* of the ionization chamber, but we could not detect such an influence.

The next point to be investigated was the question whether the material composing the plates had an appreciable influence on the measurements. To investigate this point, we covered the parallel plates with shellac containing carbon and performed the same experiment as with the brass plates. In order to compare the results of the two experiments it is necessary to make corrections for the temperature and pressure of the air and for a slight difference in the voltage applied to the roentgen-ray tube, for the experiments were performed on different days. All values of the ionization currents have been reduced to standard conditions of temperature and pressure. The curves in Figure 5 represent the results of the measurements after the above corrections have been made. The data for both experiments appear on the same diagram. The same change in the ionization current on charging and discharging the lead sheet was observed for the carbon covered plates, as indicated by the divergence of the curves at distances greater than d = 9 cm. From a distance of 9 cm. down to a distance of about 4 cm. the curves coincide very well, indicating the accuracy of the measurements and of the corrections for temperature, pressure, etc. In this region, therefore, it makes no difference whether we use brass plates or plates covered with carbon. At shorter distances, the curves diverge from each other, that for brass plates being somewhat higher than that for carbon covered plates. This divergence we interpret as being due to a tertiary radiation emitted from the plates. At these short distances between the plates, a relatively large number of photo-electrons and secondary roentgen radiation must strike the plates, producing tertiary radiation from the plates themselves. The diminution in the ionization current due to the loss of the equivalent amount of ionization is

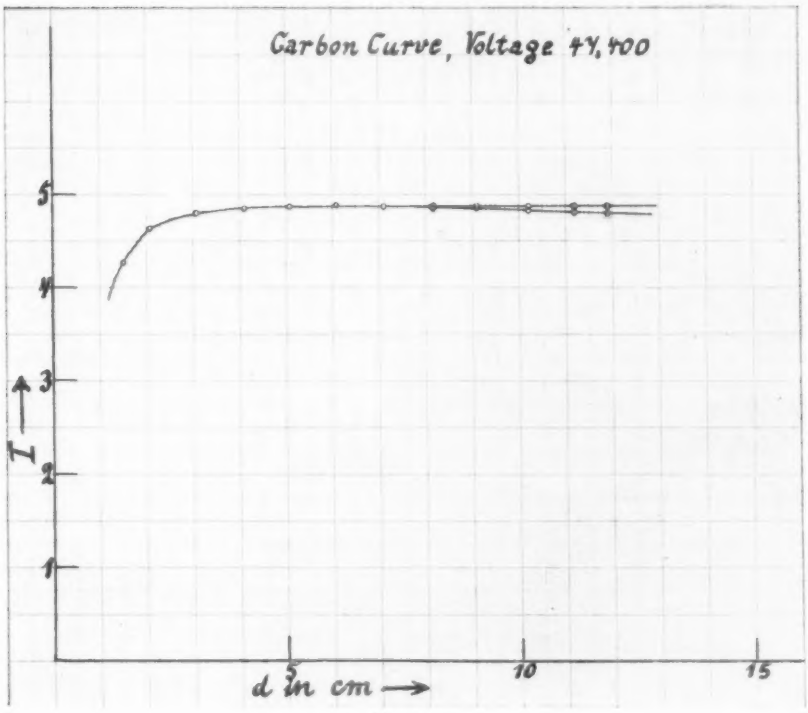


FIG. 6.

more or less compensated for by the tertiary radiation from the plates and this tertiary radiation from the plates is greater in the case of the brass than in the case of the carbon. Consequently, at these short distances, the curve for the brass plates is higher than that for the carbon covered plates.

In making accurate measurements with a standard ionization chamber substantially as described, one must use a distance between the plates lying somewhere between the point where the curve becomes horizontal, say at 6 cm., and the point where the two curves begin to diverge from each other, say at 9 cm.; for, in this region, practically the entire ionization current is measured from a given number of cubic centimeters of the air, the material of the plates has no influence on the measurements and neither has the charging of the external sheet of lead.

We have made an experiment similar to the above described experiments with a voltage of 47,400 applied to the tube. Figure 6 represents the data obtained. In this experiment, we notice the same divergence of the ionization currents beyond a distance of 9 cm. and due to the charging of the lead sheet. Toward shorter distances, the ionization current does not begin to decrease until we reach a plate distance of 4 or 5 cm. This is less than in the experiments with higher voltages as would be expected on account of the smaller penetration of the photo-electrons through the air.

We have performed another experiment with a voltage in excess of 160,000 applied to the tube. In this case, the current through the tube came from a constant voltage kenetron generating plant. The experiment showed that a distance of 5 cm. or so between the plates was sufficient to obtain substantially the entire ionization produced by the roentgen rays. The fact that about the same distance between the plates is sufficient for the more penetrating radiation as for the less penetrating radiation may be explained by the fact that a larger proportion of the ionization is due to the slow moving recoil electrons emitted from the molecules of gas when the roentgen rays are scattered. This conclusion agrees with that drawn from experiments

previously reported,[3] which have been confirmed by other investigations.[4,5]

The standard ionization chamber described in previous papers[1,2,3] has been compared with the new one used in this research. The experiment shows that measurements with the old standard are 0.7 per cent less than those with the new.

To measure and state the quality of a beam of roentgen rays we have used the effective wave length, $\lambda_e$. The effective wave length of a beam of rays in a given case may be defined as the wave length of the monochromatic roentgen radiation that would produce the same readings in the measuring instruments as are produced by the actual beam of rays. By using the proper standard curve,[1] the effective wave length of a beam of rays may be determined by making only one measurement with the measuring apparatus in addition to that which determines the strength of the beam. The value of the effective wave length, of course, depends upon the particular thing that one is measuring. We have taken for our determination of the effective wave length the absorption of the radiation in a sheet of copper 0.5 mm. thick. It is doubtful whether as much information in regard to the quality of a beam of roentgen rays can be obtained by means of a single additional measurement in any other way as by determining the effective wave length. The determination of the half-value layer requires a number of measurements, and, further, has no simple physical signification. If the absorption in a great many sheets of some material of different thicknesses is determined, one gets a more complete idea as to the quality of the radiation than by a single measurement. Further, the most complete analysis of the radiation is obtained only by the use of a roentgen-ray spectrometer. Spectrometric measurements, however, are too complicated for therapeutic uses, at present.

As illustrations of the strengths and effective wave lengths of roentgen-ray beams produced under given conditions, the data in the following table may be of interest. These values were obtained with a standard Coolidge tube containing a Tungsten target when a current of 5.94 ma. passed through it. The voltages recorded are constant, non-fluctuating voltages.

| Voltage | Focal Distance Cm. | Filter | Strength e or r | Effective Wave Length |
|---|---|---|---|---|
| 96,550 | 50 | 2 mm. Al | 0.2076 | 0.366 Å |
| 96,550 | 50 | 4 mm. Al | 0.1816 | |
| 96,550 | 50 | 0.5 mm. Cu | 0.0674 | 0.213 Å |
| 96,550 | 50 | 1 mm. Cu | 0.0303 | |
| 160,000(?) | 73 | 0.5 mm. Cu | 0.101 | 0.17 Å |
| 160,000(?) | 73 | 1 mm. Cu | 0.062 | |

## CONCLUSIONS

We may draw the following conclusions from the researches reported in this paper. Roentgen-ray dosage may be measured to a fraction of 1 per cent by means of an open air ionization chamber and galvanometer constructed and calibrated as described. The distances between the parallel plates should be from 6 to 9 cm., but may be somewhat less in the case of low voltage roentgen rays. The parallel plates should be fairly large and should extend beyond the electrode joined to the galvanometer to a distance of nearly twice the distance between the plates, in order to get rid of the effects of charges on external metal sheets. For the distances between the plates that should be used there does not appear to be any appreciable difference between measurements with brass plates and measurements with carbon covered plates, although, for shorter distances, such a difference becomes appreciable.

Through the kindness of Dr. Behnken, we have compared the readings of our standard ionization chamber with those obtained with his portable instrument. He doubtless will publish the results of these measurements after he has re-calibrated his instrument at the Reichsanstalt by means of the standard ionization chamber he described recently.[6]

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# SOME EXPERIMENTS ON THE PRODUCTION OF RAPID SERIAL ROENTGENOGRAMS FROM THE SCREEN IMAGE BY MEANS OF A CINEMATOGRAPHIC CAMERA*

BY RUSSELL J. REYNOLDS, M.B.B.S. (Lond.), D.M.R.E. (Cantab.), M.I.E.E.

LONDON, ENGLAND

THE subject of roentgen-ray cinematography has occupied my thoughts for many years, and early in 1921 some experiments were undertaken with a view to bringing the principle of cinematography in connection with roentgen rays to a really practical issue. This method of roentgen examination of the moving parts of the human body seemed to offer an entirely new field for observation and research and to be a very valuable addition to our present methods of roentgen-ray diagnosis. The method must be a true cinematographic rendering of the movements and impressions must be recorded at specific intervals. The operation must be relatively simple, inexpensive and expeditious if it is ever to be adopted universally as a routine in roentgen-ray examination.

There would appear to be only two methods to choose from: (1) The direct method by passing a moving film in front of the patient and allowing the rays to act directly on it as in the production of an ordinary roentgenogram, and (2) the indirect method by taking a photograph of the screen image with a cinematographic camera.

On account of the costliness and lack of practicability of the direct method I have directed my attention to the indirect method. As no literature could be found on the subject, progress was necessarily slow and laborious. Serious difficulties had to be overcome before even a measure of success was obtained. The details of the experiments conducted during the last five years resulting in the present form of apparatus have been dealt with in a thesis presented to the University of Cambridge in September, 1925, and in a later paper[1] read before the Röntgen Society in London in January, 1927.

This paper must be brief and will be devoted mainly to the difficulties encountered and the present methods employed.

The following points have to be considered:

(1) The light from the fluorescent screen must be brilliant enough to produce an impression on the cinematographic film in the fraction of a second.

(2) The roentgen-ray apparatus employed must obviously be powerful enough to insure a brilliant screen image.

(3) The camera lens must have a large aperture in order to allow as much as possible of the light from the screen to reach the photographic film.

(4) The film employed should, if possible, be sensitized for the particular light emitted from the particular fluorescent screen used.

(5) Adequate protection must be provided for the patient so that he will not suffer from undue exposure to radiation.

(6) It is necessary to protect the film from the direct action of the roentgen rays.

After trying very many fluorescent

[1] Reynolds, Russel J. *Brit. J. Radiol.*, 1927, xxiii, 33–44.

* Read at the Twenty-eighth Annual Meeting, American Roentgen Ray Society, Montreal, Canada, Sept. 20–23, 1927.

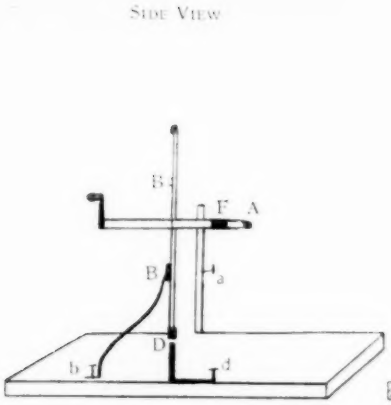


Fig. 1A.

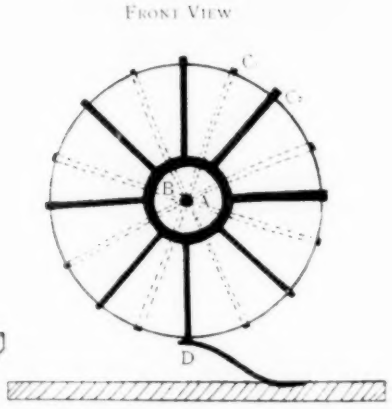


Fig. 1B.

screens up to now the writer has found the Patterson fluorescent screen (white salt) to give the most brilliant image for the purpose. An oil immersed transformer plant working a standard Coolidge tube is employed. The working details of the current are as follows: 90 kv., tube current 40 ma., filament current 3.6 amp.

The cinematographic camera is fitted with a Dallmeyer lens with a working aperture of 1.9 and a 2 in. focus. An area of 12 × 10 in. is covered when the film is at a distance of 26 in. from the fluorescent screen. The cinematographic film used is the Kodak ultra-rapid.

One great difficulty to be overcome is the protection of the patient from undue exposure to radiation. With the object of reducing the exposure to a minimum the roentgen-ray tube is excited only for the interval of time required to make the exposure. The opening of the shutter of the camera is automatically synchronized with the "making" (or switching on) of the high tension current and consequent excitation of the roentgen-ray tube, and the closing of the shutter and transference of the film with the "breaking" (or switching off) of this current.

To carry this into effect a wheel is attached to the rotating mechanism of the camera. This wheel is provided with suitable contacts to make and break the primary current of the transformer at the proper time in relation to the opening and closing of the shutter. The wheel is constructed of insulating material (fiber) and is 13 in. in diameter and ¼ in. thick. It is fixed to the horizontal axis which screws into the camera mechanism in place of the handle. This wheel has 16 copper contacts arranged at equal distances around its circumference (see Fig. 1B). Eight of these contacts, $C_1$, pass up one side of the wheel radially and make con-

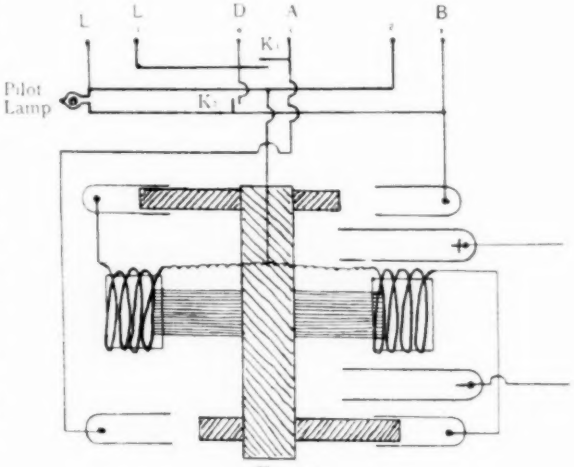


Fig. 2.

tacts with the metallic axis, A. The other 8 contacts, $C_2$, alternate with these and pass up the other side of the wheel radially but stop short of the axis and make contact with the brass ring, B. The axis is connected to the terminal, *a*, soldered to the bearing and the brass ring to another terminal, *b*, by means of a spring contact. This terminal is fixed to the baseboard

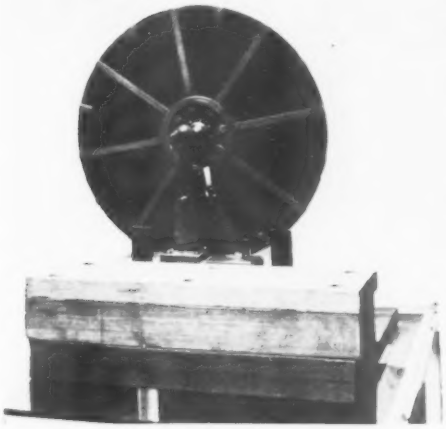

Fig. 3.

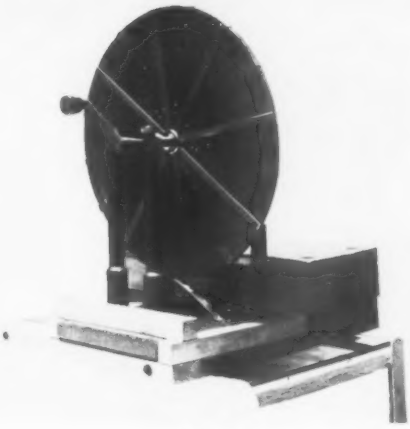

Fig. 4.

carrying the contact wheel mechanism (Fig. 1A).

As the wheel rotates the peripheral ends of the 16 copper strips make contact in turn with a fixed spring, D, connected to another terminal, *d*, also fixed to the baseboard. In this way the current passes alternately from terminal, *d*, to terminals *a* and *b*.

Figure 2 shows the connection of the electromagnetic switch immersed in oil to quench the sparking when the current through the primary of the transformer is broken. A pilot lamp is connected to the switch which lights when the high tension current is cut off, and serves to indicate when the shutter of the camera is closed.

The terminal, *a*, of the wheel is connected to terminal A of the switch; *b* and *d* to B and D respectively.

The switches $K_1$ and $K_2$ in Figure 2 correspond respectively to the making and breaking contacts of the rotating wheel as already described when considering Figures 1A and 1B.

The camera is insulated from the wheel by means of a fiber connecting-piece fixed to the axle. The position of the wheel is so adjusted with regard to the mechanism of the camera that when the current is made the shutter is open and remains open until the current is broken, which takes place when the next strip on the wheel makes contact with the fixed spring D (Fig. 1). Figures 3, 4 and 5 show different views of the apparatus set up for operation.

It is absolutely necessary to ensure a smooth movement and to start and stop with as little acceleration and retardation as possible. A small $\frac{1}{4}$ horse power electromotor has been found adequate to overcome the total resistance of the gearing, contact wheel, and camera mechanism.

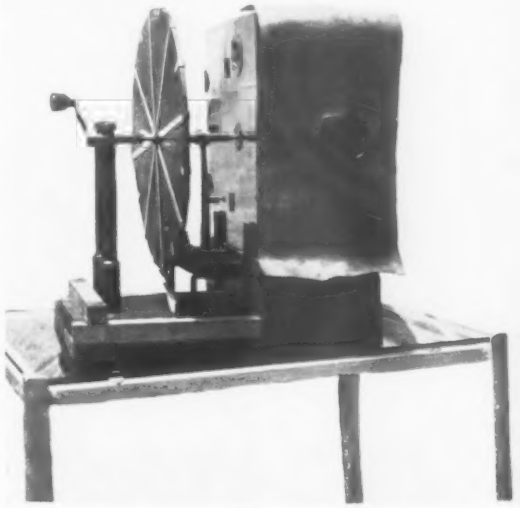

Fig. 5.

The power is transmitted to the contact wheel through a clutch controlled by a lever. (See Figs. 6, 7, and 8.) With this combination it is easy to start and stop the mechanism instantaneously and to insure that the film is passed along at a steady rate variable at will by means of a resistance in the motor circuit. Any desired

Fig. 6.

Fig. 7.

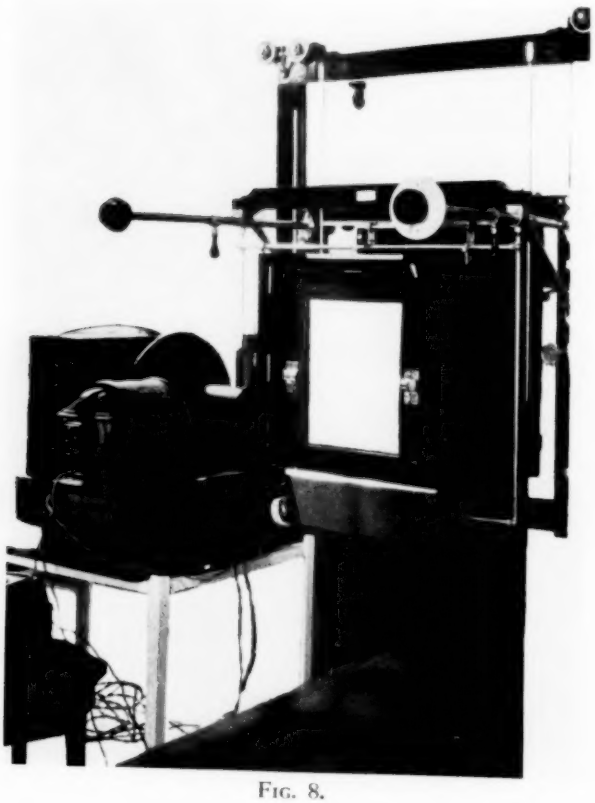

Fig. 8.

number of exposures can thus be made per second. By use of this mechanism it is clear that the patient will receive at the most only 50 per cent of the radiation he would receive if the tube was running continuously. Perhaps a simpler method of attaining this end would be by rotating in front of the tube a shutter diaphragm opaque enough to cut off the major portion of the radiation and running this synchronously with the shutter of the camera. This would of course throw a greater strain upon the roentgen-ray tube and is a very important consideration. It is impossible to run the tube for more than four or five seconds with the output of current necessary without a grave risk of overloading it.

Rates at which the exposures should be made will have to be specially worked out, depending on the subject under examination. In the cases of movements of the joints it need not be so rapid as in the examination of a thorax. An important point to be remembered is that very few pictures need to be taken, only just sufficient in most cases to give a few cycles of movement. When a positive film is prepared for projection purposes the short length of negative film can be reproduced again and again and the cycle of movement repeated as many times as desired. Thus it is not necessary to expose the patient for long to the rays.

The question of screening off roentgen rays from the photographic film has to be very carefully considered. It is found necessary to use lead glass protection in front of the fluorescent screen or in front of the lens of the camera (the writer prefers the former method), and to place lead protection in front of the camera all around the lens to insure that the direct beam of roentgen rays does not reach the photographic film. Only just sufficient thickness of lead glass must be used to prevent fogging, otherwise an unnecessary amount of light from the screen will be cut off. In estimating the thickness of the lead glass required one has to take into consideration the screening value of the combination of lenses employed as it is of the utmost importance that the maximum amount of active light should reach the photographic film.

The front of the camera is protected with 2 mm. of sheet lead in addition to a sheet brass plate which is used in its construction and a sheet of lead glass (Andrews' Protex glass) 0.5 cm. thick is placed in front of the fluorescent screen. Special care was taken to select the whitest lead glass possible.

In earlier experiments portions of the human skeleton were used to test exposures and it was possible to obtain a clear though faint impression of a human sacrum (skeleton) with exposures of $\frac{1}{32}$ of a second. Much more work has to be done before the results obtained can be of practical value in diagnosis but we are on the right road and we shall find roentgen-ray cinematography of the screen image playing a very important part in routine roentgen-ray examination of the future. In examination of the heart, the thorax and the alimentary tract, in movements of the joints both in health and disease much information will be gained by observations conducted by cinematographic methods.

In future, attention should be directed to improvements in the lens employed, to the fluorescent screen and to the sensitivity of the film—everything possible must be done to insure a maximum amount of actinic light reaching the cinematographic film.

Messrs. Dallmeyer have just brought out a lens of wider aperture which is a step in the right direction. The choice of the roentgen-ray tube is a difficult matter and possibly Dr. Coolidge's new 100 ma. tube will stand the strain better than the standard type.

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*Information of interest to all readers will be found on page ii.*


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*Thirteenth Annual Meeting:* Hotel Radisson, Minneapolis, Minn., June 11–12, 1928.

*Committee on Arrangements:* H. H. BOWING, Chairman, Rochester, Minn.; A. S. FLEMING, Minneapolis, Minn.; LEDA J. STACY, Rochester, Minn.

# EDITORIALS

## CHARLES H. VIOL, PH.D.

1886–1928

DR. VIOL was born in Lafayette, Indiana, in 1886, and after graduating from the grade schools in that city, entered Purdue University from which he was graduated in 1907 with the degree of B.S. After teaching chemistry at the University of South Dakota for two years, he won a fellowship at the University of Chicago. At this institution he specialized in radioactivity and received the degree of PH.D. in 1912. After receiving this degree, he joined the staff of the Standard Chemical Company of Pittsburgh. A year later he was made Director of the Radium Research Laboratory at Pittsburgh, in which capacity he served until his death in New York City on April 6, 1928.

His work in connection with the extraction of large amounts of radium from low-grade carnotite ore and his success in producing radium salts of high purity for therapeutic purposes has had much to do with the therapeutic advancement of radium. Other important contributions, along therapeutic lines, were the designing of an indestructible flat surface radium applicator, the development of the steel needle for radium implantation and the establishment of a means for protecting radium workers against excessive amounts of the rays.

Being in constant touch with many physicians interested in radium applications, he early became conversant with their therapeutic problems and, over a period of twelve years, delivered at stated intervals, a series of lectures on the physical aspect of the subject.

In April, 1913, he, in conjunction with his fellow workers, issued the first number of *Radium*, which publication was, for a number of years, the only one in the world devoted entirely to radioactivity and radium therapy.

Dr. Viol was a member of many scientific organizations. His interest in the American Radium Society of which he was an associate member, was, however, uppermost in his thoughts and he was ever ready to take part in scientific discussions.

It is only given to those physicians who were closely associated with him during the past few years to know what a splendid

Charles H. Viol (1886–1928).

fight he waged in trying to combat the disease that finally ended his splendid career. We can say nothing that will contribute more to his sterling qualities and his true worth than to mention the fact that he never uttered one word of complaint, or ceased his work with radium, even after he recognized that the work was probably the cause of his last illness.

He leaves his father and mother, a sister and a brother.

In his death the American Radium Society loses one of its most brilliant members and a man who has not only contributed valuable papers but whose discussions were always helpful.

## AMERICAN ROENTGEN RAY SOCIETY

### ANNUAL MEETING

Arrangements are well under way for the annual meeting of the Society which is to be held this year in Kansas City, Mo., Sept. 25–28. The headquarters, the scientific meetings and the commercial and scientific exhibits will all be at the Hotel President where the facilities offered are excellent. There have already been many applications for place on the program. It is suggested that anyone who has a paper to present communicate at once with the president-elect, Dr. E. H. Skinner, 1020 Rialto Bldg., Kansas City, Mo.

## BRITISH INSTITUTE OF RADIOLOGY

A letter from Dr. John Muir informs us that the British Röntgen Society has been amalgamated with the British Institute of Radiology. The organization is now known as "British Institute of Radiology Incorporated with the Röntgen Society." Dr. John Muir is the active director of the Institute and in addition, there are the following officers: President, Sir Humphry Rolleston: Vice-Presidents, Sir W. H. Bragg, Robert Knox and G. W. C. Kaye; Hon. Treasurer, Geoffrey Pearce; Hon. Secretaries, Stanley Melville and G. Shearer.

## CALDWELL LECTURE FOR 1928

Dr. Preston M. Hickey, professor of roentgenology at the University of Michigan, the first editor of this Journal and one of the pioneers in American roentgenology, has been chosen to deliver the Caldwell Lecture at the annual meeting of the AMERICAN ROENTGEN RAY SOCIETY which meets in Kansas City, September 25 to 28. The subject of the lecture is "The Role of Roentgenology in Laryngology," but the lecture will be introduced by a review of Eugene C. Caldwell's contributions to the advancement of roentgenology. The latter is particularly appropriate since Dr. Caldwell's birthplace was in Concordia, Kansas, only a short distance from Kansas City. Mrs. Caldwell and other relatives of Dr. Caldwell, as well as many of his old classmates, are expected to be present at the meeting.

*Subscribers to* THE AMERICAN JOURNAL OF ROENTGENOLOGY & RADIUM THERAPY *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this column solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES*

### United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Twenty-ninth annual meeting, Hotel President, Kansas City, Mo., Sept 25.–28, 1928.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los. Angeles, Calif.
Annual meeting, Minneapolis, Minn., June 13, 1928.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Minneapolis, Minn., June 11–15, 1928.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Fourteenth annual session, Chicago., Ill., Dec. 3–7, 1928.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.
Next annual meeting, Asheville, N. C., Nov. 12–15, 1928.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. R. A. Arens, Michael Reese Hospital
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, 2033 Park Ave.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. Carl S. Oakman, Muncie, Indiana.
Annual meeting each February 22 in Indianapolis. Next meeting in June, 1928.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Annual meeting, Galveston, Texas, 1928.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting Oct. 17, 1928.

### British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.

*Secretaries of societies not here listed are requested to send the necessary information to the editor.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.
Next annual meeting, Charlottetown, P. E. I., June 21–23, 1928.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague. 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.
Next meeting with the Gesellschaft deutscher Naturforscher und Aerzte will be in Hamburg, Sept. 16–21, 1928.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Fifth Annual Meeting in Kiev, Ukraine, May, 1928.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.
Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. H. Scheuermann, Copenhagen
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July

# LOCALIZATION OF FOREIGN BODIES IN THE EYE

## REMARKS ON A PAPER WITH THE ABOVE TITLE BY GORDON E. RICHARDS[1]

*To the Editor:*

The statement of G. E. Richards that the parallax method is not new is quite correct. This procedure is, in fact, one of the oldest. It is, however, incorrect to state that no mention of it is to be found in the literature.

As far back as 1899 there is to be found in the *Lancet*,[2] in the report of a meeting of the Liverpool Medical Institution the following announcement: "Dr. Grossmann described a method of Localising Foreign Bodies in the Eye by Means of the X Rays which he had employed in preference to

[1] Richards, Gordon E. Localization of foreign bodies in the eye. AM. J. ROENTGENOL. & RAD. THERAPY, 1927, xviii, 378–379.
[2] *Lancet, Lond.*, 1899, i, 1098.

Mr. M. Davidson's stereoscopic method. He utilised the movements of the eye for obtaining the parallax of the shadow of the foreign body, the Crookes's tube, the patient's head, and the sensitive plate retaining the same position in two successive exposures."

In 1902 Köhler[1] recommended this parallax method, and since then it has been repeatedly cited in the German literature under the name of "Köhler's method." In the course of time, it was demonstrated that the procedure is reliable if the foreign body does not move; the latter would then have an extrabular localization, except in the rare instance when situated exactly at the center of rotation of the eye, where obviously it could make any excursions. Movements of the foreign body, however, may easily lead to errors; if it lies in Tenon's capsule it will follow nearly all the movements of the eye, and likewise if situated in one of the eye muscles it will alter its position with the movement of the eye; (I shall return to this presently). As a result, it may happen that even after enucleation of the eye, change in the direction of vision of the other eye may cause the production of two shadows of a foreign body. Such an instance has been described by Haenisch.[2] Reichmann[3] determined a depth of 24.5 mm. in a case in which change of direction of vision produced two shadows on a film pressed close to the eye and exposed by the Fürstenau shift technique. The foreign body therefore had to lie behind the eyeball in spite of the fact that eye movement caused change in position. This diagnosis was confirmed at operation; the fragment lay in an exudate adhering to the posterior wall of the eyeball.

Concerning the movements of a foreign body in the different eye muscles, exact studies have been reported by Belot.[4] Such a foreign body alters its position in a different manner from that of an intraocular body. In the Belot method three exposures are made: with direction of vision forward, upward and downward. When normals are drawn to the line connecting the three foreign body shadows, they intersect at the center of rotation of the eye in the case of intraocular bodies, but in the case of foreign bodies in the eye muscles the intersection occurs at a point outside the orbit. Belot shows furthermore that it is possible to determine from the nature of the movement the particular eye muscle in which the particle is located. If the lateral roentgenogram of the eye directed upwards shows the shadow approaching the depth of the orbit, then the foreign body lies in the rectus superior; if the shadow moves outward, the body lies in the rectus inferior; if the shadow approaches the anteroposterior axis, the body is situated in the obliquus inferior; if the shadow leaves this axis, the body lies in the obliquus superior. In the anteroposterior roentgenogram, a foreign particle in the adducting rectus externus moves outward, but in the adducting rectus internus it moves inward.

The parallax method is therefore not so reliable as it appears; nevertheless, it is to be recommended for rough orientation. For accurate localization, however, it is inadequate and other methods must be considered. Dr. Richards states correctly that the Sweet method (as well as other similar methods) has the disadvantage that it assumes for purposes of calculation an average normal size of the eye, i.e., an average diameter of 24 mm. But the magnitude of this diameter varies between 22.5 and 26 mm. for normal eyes, and the variation may be even greater in injured eyes. In my paper on the localization of intraocular foreign bodies[1] (see also this journal[2]), I criticized the methods which arbitrarily assume a normal bulbus, because they do not permit an accurate localization. In these methods, the foreign body is determined by the relation of its position to the vertex of the cornea, which is quite adequate for the anterior regions of the eye. For the posterior regions, however, it is necessary to obtain the

[1] Köhler, A. Zur Technik des Fremdkorpernachweises im Augapfel. *Fortschr. a. d. Geb. d. Rontgenstrahlen*, 1902–3, vi, 190.
[2] Haenisch. Beitrag zur rontgenologischen Lokalisation metallischer Fremdkörper im Auge. *München. med. Wchnschr.*, 1912, lix, 2839.
[3] Reichmann, M. Zur Fremdkörperlokalisation im Auge. *München. med. Wchnschr.*, 1913, lx, 816.
[4] Belot, J., and Fraudet, H. Recherches et localisation précise des corps étrangers de l'oeil. *J. de radiol. et d'électrol.*, 1916–17, ii, 433–450.

[1] Altschul, W. Lokalisation intraokularer Fremdkörper. *Fortschr. a. d. Geb. d. Rontgenstrahlen*, 1922, xxix, 441–464.
[2] Altschul, W. Some new methods for roentgenography. Am. J. Roentgenol. & Rad. Therapy, 1927, xvii, 659–666.

relative position with respect to the surface of the eye, or at least to the center of rotation. It is obvious that the results of determinations based on the corneal vertex become more uncertain, the farther back the foreign body is situated, because the assumed normal dimension does not always agree with the actual.

For the precise localization of a foreign body, which, for instance, cannot be removed by a magnet and must be approached operatively, one requirement should be the indication to the surgeon of the point on the eye surface which lies nearest to the foreign body and thus offers the most favorable point of attack for the extraction. To meet this requirement, I have devised a method which has been published in the two papers mentioned above. My aim in this method, which likewise is based on the principle of parallax shift, has been first, to avoid all the disadvantages exhibited by the other methods, and secondly, to make the procedure as simple as possible. I believe that I have succeeded in this, because our experience for a number of years with this method shows that it is an improvement over older procedures and to be preferred to them. The determination of the *nearest point on the surface* from which extraction can be most easily made has been found to be of particular advantage, a detail which it is impossible to establish by any of the older methods.

WALTER ALTSCHUL, M.D.

## HISTORY OF ROENTGENOLOGY

*To the Editor:*

Your editorial on the "Early Development of Roentgenology" interested me very much, particularly as I can contribute a few facts in reference to American participation in the development of this epochal discovery. As a student with Dr. Wm. Harvey King of New York who was professor of electrotherapeutics at the New York Homeopathic Medical College in 1895, I discussed with him a *short excerpt* in the *Literary Digest* of January, 1896, telling of the discovery by Roentgen of the so-called X-ray. Dr. King who possessed a 12-plate Wimshurst static machine was enthusiastic about trying the new ray and procured a small Crookes tube and covering an ordinary photographic plate with black paper exposed my hand for five minutes. The plate was sent to a photographer and returned in triumph with the bones showing clearly. This, we believe, was the *first* experiment in the United States performed with X-rays and occurred January 10, 1896. Dr. King subsequently demonstrated the roentgen ray before his classes from 1896 onward and in 1900 established the first public roentgen-ray clinic at Flower Hospital, New York City, placing me in active charge. In these early days we had all inoperable and unusual pathological conditions sent to this clinic and when Dr. Senn in 1902 announced the treatment of patients with leucemia with roentgen-ray exposures, we promptly followed his lead in this and other glandular hyperplasias. An interesting experience occurred in 1903 at the third meeting of the AMERICAN ROENTGEN RAY SOCIETY at Philadelphia when in a discussion of the treatment of lupus vulgaris, the writer stated that in treating *colored* people he noticed that the black areas irradiated turned white. Dr. H. K. Pancoast of Philadelphia arose and corroborated this statement. To my surprise an enterprising reporter who had slipped into the meeting had a scare heading in the *Philadelphia North American* the following morning reading: "Dr. Dieffenbach and Dr. Pancoast claim that the X-ray can turn black people white." This statement was copied by the Associated Press and resulted in a flood of mail, amusing as well as annoying. One correspondent from Waco, Texas, wrote me as follows: "Reading of your ability to turn black people white, I desire *sole* agency for X-ray in Waco—send $15 worth of X-ray by express C.O.D. at once."

In 1904 a patient was referred who had a large *uterine* fibroid and had *refused surgery*. We exposed her to unfiltered rays and produced recession of the tumor and cessation of menses—artificial menopause. This case was reported in the *North American Journal of Homoeopathy* in August, 1904, and antedated a similar report by Albers-Schönberg of Hamburg by one year. The dermatitis in this case

was a severe one and the telangiectases resulting were still present last year when this patient was last seen, but the fibroid remained atrophic and inactive.

In 1905 the writer was appointed by President Roosevelt as U. S. Delegate to the *first International Congress of Radiology* and Ionization at the World's Fair at Liège, Belgium, and here the first papers on radium and roentgen rays were read and discussed by many prominent dermatologists of Europe. This Congress as you will note, antedated the recent International Congress of London by some twenty-two years.

William H. Dieffenbach.

New York City,
April 25, 1928.

## AMERICAN RADIUM SOCIETY

The Thirteenth Annual Meeting of the American Radium Society will be held at Hotel Radisson, Minneapolis, Minnesota, during the week of the American Medical Association conference.

The Scientific Session will convene on Monday, June 11, at 9:00 A.M., and the discussions and clinics will continue throughout Tuesday.

The preliminary program is as follows:

### MONDAY MORNING, JUNE 11, 1928

A. 9:00 A.M. Executive Business Meeting.
Report of Committees.

B. 10:00 A.M. Scientific Session.

1. Address by the President,
Curtis F. Burnam, M.D.
Baltimore, Maryland.
2. "Treatment of Hygroma Cystica with Radium."
F. A. Figi, M.D.
Rochester, Minnesota.
3. "Plantar Warts: Their Treatment by Radiotherapy."
Lawrence R. Taussig, M.D.,
San Francisco, California.
4. "Urethral Caruncle."
R. E. Loucks, M.D.
Detroit, Michigan.

C. 2:00 P.M. Executive Business Meeting.

D. 3:00 P.M. Radium Clinics.
(Cancer Institute of the University of Minnesota, conducted by Dr. A. C. Strachauer and Staff.)

E. 6:30 P.M. Annual Banquet of the American Radium Society.
Address by: William J. Mayo, M.D., of the Mayo Clinic. Subject to be announced.
Address by: A. C. Strachauer, M.D., Director of the Cancer Institute of the University of Minnesota. Subject to the announced.
Address by: S. C. Lind, M.D., Director of the School of Chemistry of the University of Minnesota. Subject to be announced.

F. 9:00 A.M. Executive Session.
Short Business Meeting.

G. 9:15 A.M. Scientific Session.

5. "A Basis for Dosage Determination in Interstitial Radiation."
Edith H. Quimby, M.A., and Hayes E. Martin, M.D.,
Memorial Hospital, New York City.
Discussion to be opened by:
K. Wilhelm Stenström, PH.D., Minneapolis, Minn.
A. Weatherwax, M.A., Philadelphia, Pa.
Curtis F. Burnam, M.D., Baltimore, Md.
Edwin C. Ernst, M.D., St. Louis, Mo.
6. "The Use and Abuse of Radium Implants."
Albert Soiland, M.D., William E. Costolow, M.D., and Orville N. Meland, M.D.,
Los Angeles, California.
7. "Experiences to Date with the Four Gram Radium Element Pack."
James J. Duffy, M.D.,
New York City.
8. "Radium in the Treatment of Carcinoma of the Uterine Cervix during 1927."
H. H. Bowing, M.D., Rochester, Minnesota, and Robert E. Fricke, M.D., Baltimore, Maryland.
9. "Mixed Salivary Tumors."
B. F. Schreiner, M.D., and Walter Mattick, M.D., Buffalo, New York.
10. "Recent Experiences with Cases of Carcinoma of the Mouth."
J. Douglas Morgan, M.D.,
Philadelphia, Pa.
11. "The Treatment of Epithelioma of the Penis by Radiotherapy and Electrocoagulation."
G. E. Pfahler, M.D., and B. P. Widmann, M.D., Philadelphia, Pa.
Discussion to be opened by:
B. S. Barringer, M.D., New York City.
Albert Soiland, M.D., Los Angeles, California.
B. C. Corbus, M.D., Chicago, Illinois.
G. E. Ward, M.D., Baltimore, Maryland.

SYMPOSIUM: "TREATMENT OF NON-MALIGNANT UTERINE LESIONS"

12. (a) "Benign Uterine Hemorrhages."
Henry Schmitz, M.D.,
Chicago, Illinois.
13. (b) "Review of the Treatment of Uterine Fibroids with Radium."
William Neill, M.D.,
Baltimore, Maryland.
14. (c) "Treatment of Hemorrhage from the Non-Malignant Uterus."
O. L. Norsworthy, M.D.,
Houston, Texas.
Discussion to be opened by:
H. H. Bowing, M.D., Rochester, Minnesota.
C. F. Burnam, M.D., Baltimore, Maryland.

All members of the American Medical Association are cordially invited by the President of the American Radium Society, Dr. Curtis F. Burnam, to attend the Scientific Session and the Banquet.

Edwin C. Ernst, M.D.
Chairman, Program Committee,
American Radium Society.

# DEPARTMENT OF TECHNIQUE

*Department Editor:* DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

*In this department will be published from time to time, as material is available, suggestions for improvement in technique.*

## A NEW ARRANGEMENT OF THE BUCKY DIAPHRAGM FOR ENCEPHALOGRAPHY*

BY EUGENE P. PENDERGRASS, M.D.

Department of Roentgenology, University Hospital

PHILADELPHIA, PENNSYLVANIA

IN making encephalograms, the patient is required to sit in the erect posture, and stereoscopic views of the head are made of each side, the posteroanterior and the anteroposterior directions. Formerly our technique consisted in utilizing the old type horizontal plate changer made for making sterescopic films of the chest. Intensifying screens and duplitized films were used. In spite of all efforts we could not get good contrast films such as one obtains in using the Bucky diaphragm. We also found that we needed films as nearly technically perfect as possible for interpretation. In encephalography, unlike ventriculography, a great deal of importance is placed upon the presence or absence of visible cerebral fluid pathways over the surface of the brain, and the variation in space between the surface of the cortex and the inner table of the skull. Displacement, distortion and obliteration of the lateral ventricles or its horns are of great importance in both procedures, that is, encephalography and ventriculography.

We found very early that one could easily misinterpret the roentgen-ray findings, especially in unsatisfactory films and when there was strong clinical evidence of the lesion being present in a certain location. As we had gone through this experience in ventriculography, we set about at once to see if we might not utilize a Bucky diaphragm in encephalography.

Fortunately, we found that we could utilize the same Bucky diaphragm[1] that we used in making ventriculograms. The only additional parts necessary were two steel brackets with which one could hang the Bucky diaphragm over the horizontal plate changer.

The technique that we suggest requires the following apparatus:

1. An adjustable horizontal plate changer, one which moves up and down in order that it may easily be accommodated to the heights of different individuals. This plate changer can be angled backward or forward in addition.

2. A Bucky diaphragm, size 11 × 14 inches. The diaphragm is hung over the top of the plate changer by the two steel brackets. There should be a head band to hold the head firmly, in order to prevent movement during respiration. The tray for holding the cassette has to be equipped with retention clamps so that it can be placed in an erect or tilted position without allowing the cassette to fall. The cassette must be so placed in the tray that it may be as near as possible to the shoulders of the patient, since it is the shoulder that prevents the head of the patient from being placed in the center of the Bucky diaphragm. The Bucky diaphragm should be equipped with a time switch, which, when released, automatically exposes the film to the roentgen rays (Fig. 1).

3. The patient has the air injected into the spinal canal in the operating room and is usually brought to the roentgen-ray department on this adaptable table which can be converted into a chair. This chair is then rolled into place and the films are made.

4. A tube stand and a 30 ma. radiator

[1] Pendergrass, Eugene P. A new arrangement of the Bucky diaphragm for ventriculography. AM. J. ROENTGENOL. & RAD. THERAPY, 1927, xvii, 358–359.

* Presented at the Clinical Meeting of Roentgenologists, Philadelphia, Jan. 27–28, 1928.

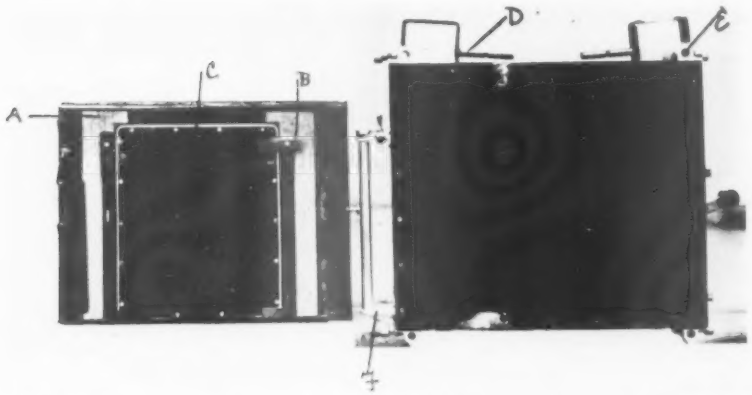



FIG. 1. Part of the Bucky diaphragm. A. Wooden frame for holding cassette toward the lower portion of the tray; B. Retention clamps. C. 10 × 12 cassette. D. Brackets for holding diaphragm over the plate changer. E. Opening into which the brackets are placed. F. Winch used for tightening a head band which keeps the head still during breathing.

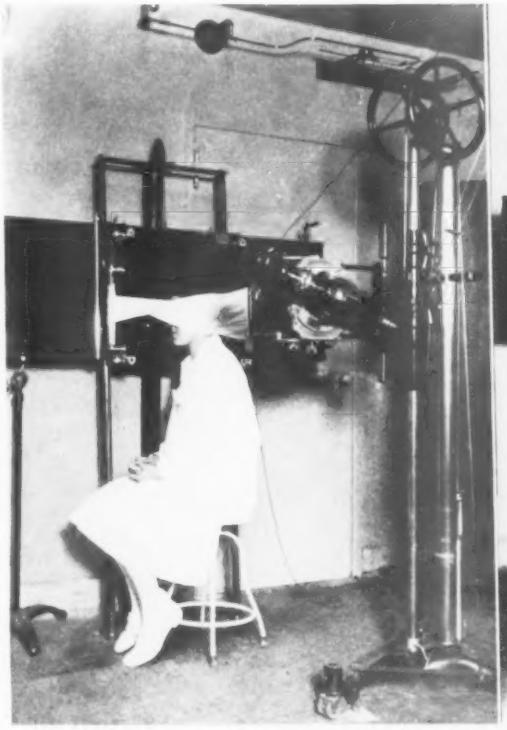


FIG. 2. Position for lateral stereoscopic films, the diaphragm being suspended over the horizontal plate changer by the brackets shown in Figure 1.

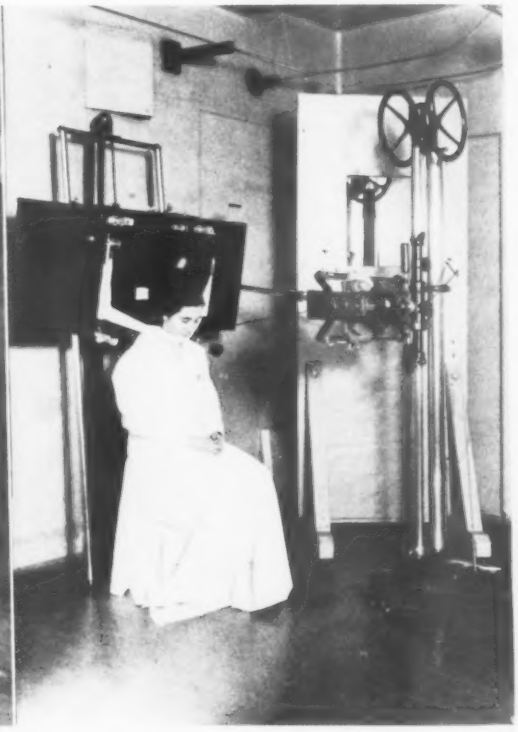
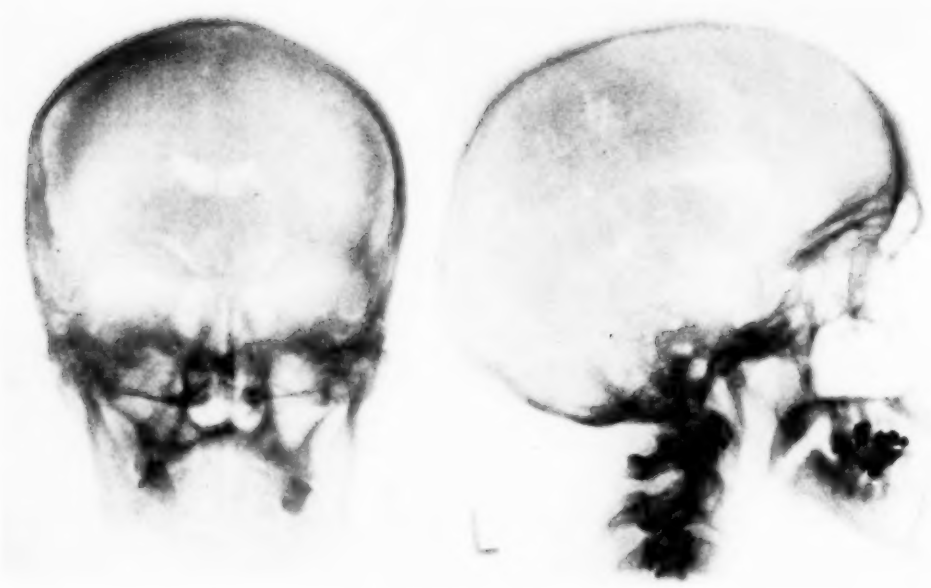


FIG. 3. The anteroposterior view, the chin being flexed on the chest and the Bucky diaphragm angled sufficiently to prevent superposition of the accessory sinuses over the air-containing ventricles.

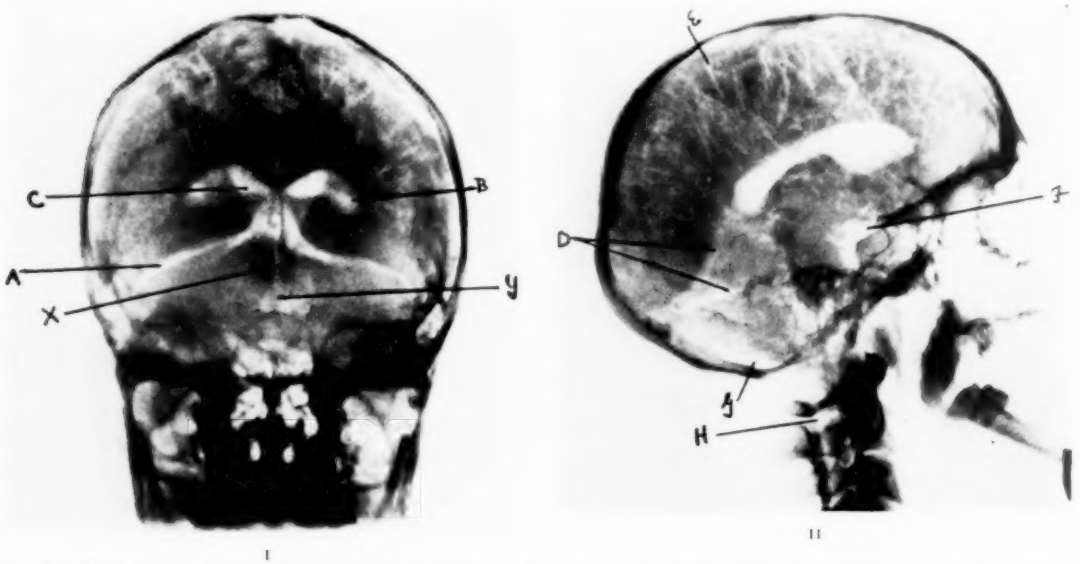
tube are used with a skin target distance of 40 inches. This skin target distance is preferred for two reasons: (*a*) it lessens the distortions from diverging roentgen rays, and (*b*) it allows freedom in moving the operating chair between the tube stand and the plate changer.

5. In making the stereoscopic views we prefer the lateral shift when making the films of each side of the head. In making the films of the anteroposterior and the posteroanterior positions, an upward down shift is preferred, because this keeps the midline of the skull in the center and allows



A B

FIG. 4. The films were exposed without the aid of the Bucky diaphragm. A. The posteroanterior view, in which it is very difficult to demonstrate clearly the cerebral fluid pathways over the surface of the cortex. B. Lateral view.




I II

FIG. 5. Films exposed with the aid of the Bucky diaphragm. I. A. Tentorium. B. Posterior horn. C. Anterior horn. X. Third ventricle. Y. Fourth ventricle. II. D. Tentorium. E. Cerebral fluid pathway. F. Cisterna chiasma. G. Cisterna magna. H. Air surrounding and clearly outlining the spinal cord.

one to easily determine any lateral deviation of the ventricles. The only other thing of note is that care should be taken to see that the chin is flexed on the chest when making the anteroposterior and posteroanterior films, in order that the frontal sinuses which may be large, may be thrown out of the field of the air-containing ventricles. Large frontal sinuses may cause some difficulty in interpretation when they are superimposed upon the ventricles. This position is greatly facilitated by the backward and forward angulation of the plate changer (see Figs. 2, 3, 4 and 5).

# INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

## ROENTGEN DIAGNOSIS

ALEXANDER, EMORY G., and CRAWFORD, WILLIAM H. Multiple giant-cell tumors. *Ann. Surg.*, 1927, lxxxvi, 362–373.

The authors report a case of giant cell tumor occurring in a man aged twenty-two, admitted with a fracture of both femurs in the middle third and the right humerus at the junction of the upper and middle thirds. The roentgen examination showed beside the fractures that all the bones were involved in a pathological condition described as follows: There was a generalized fibrocystic osteitis with an atypical appearance in the different regions, which in the distal end of the radius and the lower extremity of the left femur had advanced to that of a giant cell tumor. In the region of the elbows, it had the appearance of a chronic osteomyelitis. In the right femur the appearance suggested strongly the possibility that the process had undergone a sarcomatous degeneration. Several biopsies from selected areas showed giant cell tumor and cultures taken were negative for organisms.

No cases of multiple giant cell tumors have been accepted as true entities by the Committee on Bone Sarcoma. Dr. Codman in a recent communication states that he is skeptical about the existence of the condition. The authors report the above case while admitting no knowledge as to the previous pathological conditions existing at the areas biopsied or what changes may take place in the course of a few years should the patient live.

A collection is given of the cases reported in the literature in which multiple giant cell tumors were supposed to exist either alone or in conjunction with other bone changes. Four of these cases come from American literature and 6 from the foreign literature.

ARKUSSKI, J. The question of the roentgen diagnosis of congenital heart defects. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 455–460.

The author presents a discussion based upon 23 cases, 2 of which were confirmed at autopsy. The roentgenological method may be made to play an important part in the diagnosis of congenital heart anomalies. The shape of the heart in general, and of the heart chambers in particular are important elements in the roentgen study. Most authors when interpreting the retrosternal space in the first oblique diameter are of the opinion that the left ventricle may be visualized there. The author was able to confirm at autopsy the fact that the right ventricle may be visualized in the retrosternal space in hypertrophy.

In the 23 cases observed by the author, there were 2 of open foramen ovale, 4 of defect of ventricular septum, one of stenosis of the pulmonary artery, 4 of stenosis of the pulmonary artery combined with defect of the ventricular septum, 9 of open ductus Botalli, one of stenosis of the aortic isthmus, 2 of visceral situs transversus totalis. A report is given of a case of open ductus Botalli occurring in a girl aged seventeen. Roentgenoscopically there was observed typical mitral heart, hypertrophy of the left and right ventricles with medium enlargement of the right auricle. There occurred a pronounced pulsation of the second arch synchronously with the left ventricle and the aorta. The roentgenographic diagnosis confirmed the clinical. This case came to autopsy and confirmed the diagnosis. In all such cases the hypertrophy of the left ventricle and the appearance of the arch of the pulmonary artery are constant occurrences.

The second case described was one of combined stenosis of the pulmonary artery and defect in the ventricular septum occurring in a girl aged twelve. Roentgenographically, in the horizontal position, the contours of the first ventricle were rounded, there was widening of the aortic shadow, pronounced narrowing of the retrosternal field and a medium narrowing of the retrocardial field along the whole length. From the configuration of the heart and the aorta and the orthodiagraphic measurements, together with the clinical observations, it was possible to exclude acquired heart disease. The pronounced hypertrophy of the right ventricle suggested a stenosis of the pulmonary artery. The fact that the arch of the pulmonary artery was sunken instead of prominent indicated that the blood was passing from the right ventricle into the left, hence the diagnosis of stenosis of the pulmonary artery complicated by a defect in the ventricular septum. This case came to autopsy and the diagnosis was confirmed. Two other cases are

briefly described. The author expresses the opinion that there is a definite roentgen picture corresponding to each congenital cardiac defect, based upon the circulatory mechanism involved, provided other complications do not render the picture too involved.

BARBACCI, P., and MOGGI, B. A case of megacolon and megasigmoid. *Radiol. med.*, Dec., 1927, xiv, 1061–1068.

The patient was a child ten months of age, admitted to the hospital Feb. 1, 1927. He was born normally at term; only a small amount of meconium was passed after birth and he was always stubbornly constipated. It was often necessary to give enemas. On the first of May his abdomen became distended and he had a temperature of 37.5°. He was taken to a physician who prescribed calomel and enemas. His mother's milk was insufficient and a long period of insufficient feeding had reduced him to a very poor condition of nutrition. On admission his abdomen was distended but not excessively. On palpation a long fusiform mass could be felt extending in an oblique transverse direction across the abdomen which showed contractions progressing from right to left. On the right, a mass protruded above the crest of the ilium which did not show any resistance, but when it was compressed returned to its original position as soon as the pressure was released. Evidently there was an obstruction in the intestine and intense contractions with dilatation of a large tract above the obstruction. Roentgen examination confirmed the diagnosis of megacolon and megasigmoid. The child improved under treatment but died of an intercurrent disease after he was discharged. This case was evidently not one of true congenital megacolon, but there was probably an abnormally long sigmoid at birth and the drastic purgatives given and the exaggerated peristalsis caused by them brought about gradual elongation and dilatation of the colon.

BÁRSONY, THEODOR, and KOPPENSTEIN, ERNST. A new method for the roentgen examination of the cervical spine. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 593–594.

There is a great need for roentgenographic technique which will satisfactorily reveal the whole cervical spine in frontal view even in thick-set individuals and also a technique for satisfactory roentgenograms of the same section in sagittal view. Experiments by the authors have resulted in a technique whereby the second of the above problems has been solved. By oblique projection of the atlas there is obtained a clear sagittal view of the whole cervical spine.

The technique is as follows: The patient lies on his back on the Potter-Bucky diaphragm in such a manner that with the neck extended the head is bent somewhat forward and slightly to one side, a pillow about two to three fingers width high being placed underneath the head. The roentgen tube is centered on the Adam's apple. It is important to prevent the subject from following the movement of his head with his body. The roentgenograms are taken at a focal plate distance of 60 cm. A well-exposed roentgenogram should be taken and in the satisfactory picture the ascending horn of the mandibula should be projected into the third or fourth upper cervical vertebra. In the somewhat overexposed picture the shadow of this structure is so slight that it does not interfere with a good picture of the vertebrae. When the head is not turned sufficiently to one side the epistropheus appears to be free medially from the ascending branch of the mandibula, and the ascending ramus in such cases crosses the deeper vertebrae but even this does not interfere if the roentgenogram is slightly overexposed.

BECK, EDUARD. The roentgen diagnosis of duodenal ulcer. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 623–627.

Roentgenoscopically the duodenum assumes different appearances depending on the sex of the individual and the physique. Position and shape are subject to wide variations. The position of the duodenum varies in the same individual according to the fullness of the intestines and especially the stomach, and in this respect the roentgen literature is rather scanty. The pars superior duodeni assumes a sagittal course when the stomach is full, while at other times its course is transverse. Distortion helps to explain the prominent bulb in cases of pathological duodenum; excepting in cases of pronounced ptosis or achylia, the prominent bulb is pathognomonic for organic changes in the pars superior duodeni or of the pylorus. A differential diagnosis between changes in the duodenum and those of the pylorus cannot be established on the basis of the appearance of duodenal residues.

The above conclusions are based on 6 illustrative cases of chronic duodenal ulcer, the diagnosis of which was established clinically and by anamnesis and ultimately confirmed at operation.

Bell, Joseph C., Keith, J. Paul, and Keith, D. Y. Chronic obstruction of the duodenum. *Radiology*, July, 1927, ix, 15–22.

This is a review of the present information on obstruction of the duodenum, in which roentgenologic findings in each type are presented. It is possible, by keeping in mind the manifestations brought out here, to reveal definite basis for diagnosis in a fair proportion of cases suffering from chronic gastrointestinal disorders. Characteristic roentgen findings will usually be obtained in chronic partial obstructions of the duodenum due to kinking, of abnormal bands about the junction of the first or second portions, or about the duodenojejunal junction, or by pressure by the root of the mesentery. A fairly large proportion of cases of chronic gastrointestinal symptoms show roentgenologic evidence of partial obstruction of the duodenum. Abnormal mobility of the ascending colon is often noted when examined in the upright and supine positions.

Bergamini, Herbert, and Shepard, Lorrin A. Bilateral atelectasis (massive collapse) of lung. *Ann. Surg.*, 1927, lxxxvi, 35–40.

Reports are given of 2 cases in which sudden death occurred during operation. The autopsy finding was massive collapse of the lungs. As is well known, when the massive collapse is unilateral the condition is ordinarily benign. However, if the involvement is bilateral the result is sudden death.

In the authors' opinion the extreme rapidity of onset of such cases tends to disprove the obstruction theory of the etiology of the condition. In the 2 cases reported, there was no evidence of gross obstruction of the bronchi of the collapsed lungs at necropsy. The histological appearance of these lungs strongly suggests that the cause of the atelectasis may be a vasomotor disturbance of reflex origin, possibly identical with or closely akin to angioneurotic edema. It is urged that in cases of death during or after operation from obscure causes where necropsy is not feasible, post mortem roentgenograms of the chest be taken to determine whether or not massive atelectasis is present.

Brown, Samuel. Foreign body in the colon: case report. *Radiology*, Aug., 1927, ix, 163–166.

Five months after operation for gallstones, this patient entered the hospital complaining of weakness and the loss of 65 pounds in weight. There was pain in the lower tip of the left shoulder blade radiating to the lower left groin. A pyelogram showed a slight elongated shadow within the lumen of the transverse colon in the neighborhood of the left kidney. Further examination by means of the Potter-Bucky diaphragm gave a somewhat clearer picture. Roentgenograms made after barium meal obscured this shadow, however. The day before operation was planned, the patient passed what appeared at first to be a tape worm, but which proved to be a piece of surgical gauze 42 inches in length. The following day the patient was discharged from the hospital. The peculiar feature of this case is that the roentgenologist was able to see the gauze, which gave a faint shadow. Illustrations are submitted to show this peculiar condition, before and after removal of the gauze, and also the roentgenogram with barium meal.

Businco, O. Roentgen appearance of echinococcus of the lung. *Radiol. med.*, Dec., 1927, xiv, 1124–1147.

The author presents roentgenograms illustrating the different appearances which may be presented by pulmonary hydatid cysts. He has seen 15 cases. In all of them there was slight and repeated hemoptysis, pain in the chest and dry and persistent cough. In 9 of the cases the cyst was on the right side, with a predilection for the lower lobe; in 5 it was on the left. It was bilateral in only one case. The roentgen diagnosis was verified by surgical operation, the presence of fragments of cyst or vesicles in the expectoration and, though more rarely, by positive biological research. In Sardinia, where the author's work was done and where this disease is common, it seems from recent statistics to be increasing, but he believes this is not due so much to an actual increase in the disease as to better methods of diagnosis, particularly the greater use of roentgenoscopy.

He thinks the most frequent localization is in the liver, followed by that in the lung and for various reasons thinks direct passage from the liver to the lungs through the diaphragm is impossible. The opaque cords in the diaphragm visible in the roentgenograms which the author presents do not represent the path traversed by the echinococci, but are due to interstitial pneumonia or are signs of irritation of the pleura.

The roentgen pictures show cysts of different sizes, from that of an apricot to that of the head of a fetus, either simple or complicated by irritation of the pleura or lungs or by suppuration.

He then describes metastatic echinococcus cyst based on the observations of Devé and Masci. It was Masci who gave the first roentgen

description of this disease. He gives the following summary of the roentgen appearance of echinococcus cyst of the lungs: (1) Primary, uncomplicated cyst gives an oval picture the size of a nut to that of the head of a fetus in the lung field; it is uniform and light in color. The oval, not round, form of the cyst is important in differential diagnosis and a search should be made for it in all projections. (2) Metastatic echinococcus shows many little shadows the size of a cherry scattered irregularly over both lung fields. The heart shadow, which is the most frequent site of the primary cyst (75 per cent in the author's cases) may be enlarged and deformed on the right side.

CAESAR, FRIEDRICH. Isolated fracture of the coracoid process and its roentgenological demonstration. *Fortschr. a. d. Geb. d. Röntgenstrahlen.* 1926, XXXV, 519–520.

A report is given of a case occurring in a laborer. The diagnosis was established by the symptoms of local pain and crepitation. There was pronounced pain on pressure on the coracoid process. For the roentgenological demonstration the author recommends a position of the tube somewhat different from the usual. The patient lies on the back with the upper arm outstretched, the roentgen tube being pointed as for the usual shoulder joint technique, 5 cm. below and 10 cm. from the midline, the central ray being directed toward the coracoid process, *i.e.*, the direction being from in front inward below toward the back, outward, upward. By this means the process is found to lie free in the triangle formed by the clavicle, acromion and spine of the scapula.

CASE, JAMES T. Chronic obstruction of the small intestine. *Radiology*, July, 1927, ix, 1–14.

This is a discussion of the present status of information on chronic obstruction of the small intestine. The various conditions discussed are illustrated with roentgenograms. Drawings illustrating the normal duodenal motor behavior are also given. The necessity of knowing the activity of the normal duodenum is emphasized, otherwise roentgenograms of supposed pathologic conditions may be misinterpreted.

CASTRONOVO, E. Some congenital malformations of the duodenum and their relation to clinical conditions. *Radiol. med.*, Dec., 1927, XIV, 1077–1099.

A series of congenital malformations of the duodenum extending from the simple scoliosis or kink described by Busi through complex abnormal formations of the loops of the duodenum, dislocations of the third portion and ectopies of the duodeno-jejunal angle to free duodenum is described. The author tries to determine the cause of these abnormalities in the embryological development of the duodenum and from his own observations studies the relations of these malformations to the different clinical syndromes which the patients show; he denotes the complexity and variety of these syndromes and finds that these malformations may cause no symptoms at all until some new factor is added. This factor may be mechanical, nervous or inflammatory and the latter may be endogenous or exogenous. He studies these malformations in relation to malformations caused by periduodenitis, shows the necessity of making a distinction between them and finds that a secondary periduodenitis may develop as a result of the congenital malformations.

He then shows that malformations of the duodenum may be associated with other congenital malformations in other parts of the intestine, such as dolichocolon and common mesentery. These anomalies are not as well known as they should be by the physician and surgeon; the surgeon may be absolutely confused by them in operations on this region. He also shows the possible good effects of operation in serious cases, even when the symptoms are purely nervous, for instance such operations as duodenopexy or partial or total exclusion of the duodenum.

COSTANTINI, D. A case of Paget's bone disease. *Radiol. med.*, Dec., 1927, XIV, 1105–1115.

A case of Paget's disease is described in which the roentgenograms showed bone lesions that were quite different in the different parts of the skeleton examined, so much so that they might have been thought to come from different individuals. The differential diagnosis from chronic infectious osteomyelitis, tuberculosis and syphilis of the bone, Recklinghausen's fibrous osteitis and Virchow's leontiasis would have been very difficult if other data had not been available, such as the clinical course, the enlargement and irregularity of the bones and the malformations characteristic of Paget's disease and the findings on biopsy, which showed beyond doubt that there were two distinct processes, a productive osteitis and a destructive osteitis. The roentgen picture was the typical picture of Paget's disease only in the tibia, while the picture in the radius was more like that of Recklinghausen's fibrous osteitis. In the skull only the frontal bone was affected.

The author concludes that roentgen examination of the skeleton is very difficult because the osteopathies from unknown causes, including Paget's deforming osteitis, Recklinghausen's fibrous osteitis and Virchow's leontiasis ossea, (Recklinghausen adds rickets and osteomalacia also) cause changes which are very variable in form, site and distribution, as only the calcareous part of the skeleton can be studied roentgenologically.

Cottle, George F., and Spalding, Otis B. Value of x-ray in diagnosis of perforated duodenal ulcer. *Ann Surg.*, 1927, lxxxv, 450–456.

Eight cases of perforated ulcer of the duodenum diagnosed on naval vessels afloat are reported. All but one were operated upon within ten hours of onset and all recovered. A roentgen finding in these cases is reported which is believed to be of more value when found than the usual unsuccessful search for diminished liver dullness. The clinical picture is usually definite and convincing but there are cases in which the symptoms are not so striking and conclusive. It occurred to the roentgenologist that the roentgenogram might help in these cases and experience has shown that it does.

An amount of gas too small to reveal its presence by percussion will show with unmistakable clearness on the roentgen plate. When found by roentgen examination its presence has been verified at operation by the sound of gas escaping from the peritoneum when first nicked by the surgeon's knife. This roentgen finding is not always present and its absence should not lead to a denial of the existence of perforated ulcer. This sign is especially valuable when the patient is first seen in the stage of reaction or at the onset of peritonitis. It may help the surgeon to distinguish between the acute perforated appendix and the perforated ulcer, and thereby shorten the search on the operating table. Roentgenograms are taken with the patient on his face, and with the patient on his left side. This procedure may be objected to on the ground that such movements may disseminate the escaping gastrointestinal contents but this danger is more than overshadowed by the danger of unnecessary delay. It is a matter of but a few moments after taking the plate before the roentgenologist can report a positive or a negative finding.

Cramer, H. On deep-seated hindrances to duodenal passage. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 523–530.

A report is given of a case occurring in a girl twelve years old suffering from congenital duodenal stenosis, confirmed at operation. The case had been under observation since 1924 and during that time exhibited three different phases. During the first phase there occurred complete emptying of the entire widely dilated duodenum, with pyloric insufficiency and gastric ectasia caused by regurgitation. In the second phase there occurred decompensation, which at the beginning was accompanied by enormous dilatation of the duodenum which became filled by contrast meal only after a half hour to an hour and then never completely. The dilated lumen was filled with bile and pancreatic juice. In spite of difficulty in securing early filling of the duodenum it was possible to diagnose an extragastric stenosis through discovery of the presence of a gas bubble in the ileum lying to the right of the stomach. In the third phase, after performing a gastroenterostomy, the duodenal passage was greatly improved so that among other things pyloric closure was again evident. In other words, in this case pyloric insufficiency was caused passively by kinking of the small intestine.

The author reviews the various factors causing modification in duodenal motility and emptying and gives an extensive bibliography on this phase of the subject. The condition of the pylorus and the rate at which it empties is of considerable importance. Ideas regarding the physiology of the pyloric reflex should be made to conform to more modern points of view. As to the pathology of duodenal motility, one must consider the complex effects of functional and organic conditions as related to the function of the duodenojejunal flexure. Attention is directed to the work of French and American observers who have emphasized the important relations existing between hindrances to duodenal passage and certain toxic and nervous general symptoms partly explained by the absorption of protein split-products.

D'amato, G. A hitherto undescribed anomaly of the bones of the foot. *Radiol. med.*, Jan., 1928, xv, 11–12.

The author describes and presents a roentgenogram of an anomaly in a man aged twenty-five. There was a supernumerary metatarsal implanted on the diaphysis of the fourth metatarsal. He does not think this was a congenital malformation as it occurred only in the left foot and an anomaly of this kind could not be a reversion to a type found in the lower animals. He thinks from the roentgen picture that it was brought about by a division of the

center of ossification of the fourth metatarsal with development of the two portions at different times.

Donaldson, S. W. Examination of the mastoids by using a serial plate changer. *Radiology*, May, 1927, viii, 437–438.

The following routine procedure is used by the author in taking roentgenograms of mastoids: "A gastric plate changer is set upon the angle board and the ear of the patient placed over the aperture. After each exposure the cassette is shifted with the stereoscope shift of the tube. This uses the lower half of a 11 × 14 film. The opposite ear is then placed in the same position and the upper half of the film exposed by the same method. This gives four 5 × 7 exposed areas on one film.

"When the film is dry it is then cut so that one right ear and one left ear is on either side of the strip. When set up with the stereoscope both mastoids can be studied and compared with more ease than when separate films are used."

Dwight, Kirby. Benign hypertrophy of the stomach and linitis plastica. *Ann. Surg.*, 1927, lxxxv, 683–697.

As formerly used, the term linitis plastica designated all the conditions of hypertrophy and induration of the stomach not obviously malignant. As now used, it refers to a group of cases, probably malignant, with a definite micro-pathology but with a disputed interpretation of that pathology. It separates the cases of evident malignancy from those that are clearly benign. The benign group can be subdivided into cases of hypertrophic pyloric stenosis; fibromatosis; cirrhosis; chronic inflammation, syphilis, etc. A few cases are reported which are probably examples of chronic inflammation.

All these benign conditions may resemble linitis plastica and one another to such a degree that careful microscopic examination is necessary to differentiate them. When the lesion is confined to the pyloric half of the stomach the roentgen picture closely resembles that of carcinoma of the pylorus and the operation is likely to be undertaken under that diagnosis. In this condition it is impossible to tell at the time of operation whether one is dealing with a benign or a malignant process.

In the opinion of the author, a partial gastrectomy with a Pólya anastomosis is the operation of choice under these circumstances.

Eisendrath, Daniel N., and Arens, Robert A. A further study in normal pyelograms and the value of bilateral simultaneous pyelography. *Radiology*, May, 1927, viii, 422–426.

The authors have continued their studies of normal pyelograms. The present paper is an enlargement on a previous communication, in which they have grouped pyelograms as (1) ampullary, (2) bifid and (3) "pseudospider," and some unusual examples belonging to these groups are given.

The ampullary type is by far the most common. All degrees of variation are found, both in size of the pelvis and in the size, mode, origin, etc., of the major calyces. Reproductions of pyelograms are offered to illustrate these variations. The bifid type is also subject to variations and unusual shapes, as is readily shown by pyelograms. The authors then discuss the advantages of simultaneous bilateral uretero-pyelography. No alarming or disagreeable symptoms were encountered in a series of 100 cases examined by this method. After plain roentgenography, 12.5 per cent sodium iodide is injected on both sides through a No. 5 (Pasteau size 10) catheter until resistance is felt. An exposure on 11 × 14 film is then made to include both renal pelves. Injection is then continued until both catheters have been withdrawn, when a final exposure on a 14 × 17 film is made; this includes both renal pelves and the entire ureter. This enables both the urologist and the roentgenologist to note the existence of pathological changes on the opposite side and to determine the degree of dilatation of the pelvis and calyces, the relative position of the two kidneys, etc.

Fantus, Bernard. Peroral administration of colloidal contrast medium in cholecystography. *J. Am. M. Ass.*, July 16, 1927, lxxxix, 182–187.

There are several objections to the use of capsules for administration of phenoltetraiodophthalein for cholecystographic purposes. One of the difficulties is that the capsules may open in the stomach and produce nausea and vomiting or they may not disintegrate at all or promptly enough. Another serious objection is the opening up of the capsules and the possible discharge of their very irritative contents in concentrated form against the mucosa of the bowel. In one of the author's patients with a duodenal ulcer these capsules produced such a severe attack of abdominal pain that hypodermic injection of morphine and atrophine became necessary.

For these reasons and also because patients are occasionally encountered who cannot or will not swallow capsules, the author undertook experiments to determine whether the dye

might possibly be given by mouth without encapsulation. The problem presented two aspects: (1) reduction of the alkali irritation produced by the soluble dye salt, and suppression of the emesis, and (2) protection of the dye against precipitation by the acid of the gastric juice. To reduce alkali irritation the minimal effective dose was determined as less than 2.5 gm. for the adult. The demulcent vehicle which is probably most satisfactory is cream and water in equal parts. To control the gastric acidity the author administers a mixture of sodium bicarbonate and precipitated calcium carbonate before administration of the dye and at half hour intervals in the evening until the patient is asleep. The procedure yields satisfactory cholecystograms but vomiting of the patients occurred in a number of cases.

The author also produced the dye in colloidal form by adding carbonated water to the dye solution. This colloidal precipitate was stabilized with a very dilute tragacanth mucilage. This looks like milk and is not offensive to the taste. Apparently the solubility and absorbability of the agent was increased because 1 gm. of the dye was sufficient to produce a shadow in a normal person. The author recommends a 2 gm. dose as most suitable. This colloidal preparation renders cholecystography very simple.

FRIEDENWALD, JULIUS, FELDMAN, MAURICE, and KEARNEY, FRANCIS X. Further experimental studies in cholecystography. *J. Am. M. Ass.*, July 16, 1927, lxxxix, 195–196.

There still appears to be some doubt as to the degree of toxicity and the lesions that may be produced by tetraiodophenolphthalein when administered by the oral route. This appears important since at times the dosage required must necessarily be very large. Experiments are reported on dogs injected with various amounts of the dye given in divided doses within a period of less than two months. The animals were finally killed and the liver and kidneys studied histologically. The results of the examinations show that regardless of the quantity of dye given, all the dogs, controls and experimental animals, showed some change in the kidneys and liver. In no instance was there evidence of degeneration or of necrosis. In 5 instances in which catheterized specimens of urine were examined following administration of large doses of the dye, no abnormal conditions were revealed. This is entirely in accord with observations in human beings following the use of the dye for gall-bladder visualization.

The dye appears to be absorbed not only in the large bowel but also in the small intestine. It may therefore be concluded that tetraiodophenolphthalein administered orally for purposes of cholecystography, even when given in massive doses, does not produce degenerative or necrotic changes in the liver or kidneys.

FRIEDENWALD, JULIUS, FELDMAN, MAURICE, and KEARNEY, FRANCIS X. Experimental studies in cholecystography. *Radiology*, July, 1927, ix, 68–72.

The visualization of the gall-bladder by the oral administration of tetraiodophenolphthalein is unsatisfactory because in no instance could a gall-bladder shadow be obtained. This is due to the high gastric acidity which alters the dye into an insoluble salt. Even when introducing the dye directly into the small intestine, a gall-bladder shadow is not always obtained unless the gastric secretion is eliminated by tying off the duodenum. For this reason, large doses of the dye should be administered to be sure that a sufficient amount passes into the small intestine in an unaltered form. The visualization of the gall-bladder is not influenced by food or alkalies.

GAVAZZENI, L. Tolerance by the digestive tract of a large number of needles. *Radiol. med.*, Dec., 1927, xiv, 1068–1070.

A young girl in an attempt at suicide swallowed a package of needles. A roentgen examination revealed about 40 needles scattered through the abdomen, one group being localized in the stomach, another in the duodenum and others scattered through different parts of the colon. Needless to say the number of needles and their wide distribution made surgical operation impossible. The patient was kept under observation and the needles were passed gradually in the feces. She is now in excellent health, some months after the incident and the number of needles passed is approximately the number seen on roentgen examination. This case shows that the prognosis is not necessarily bad in cases which at first glance might seem hopeless; operation should not be performed hastily but the patient should be kept under observation and operation performed if any serious signs due to the presence of the foreign bodies in the intestine develop.

GIONGO, F. Roentgen picture of the upper urinary tract by means of pyeloscopy. *Radiol. med.*, Jan., 1928, xv, 17–45.

Pyeloscopy is one of the most recent methods

of roentgen diagnosis of diseases of the urinary tract. It consists in observing the way in which an opaque liquid diffuses in the renal pelvis and studying the appearance presented by the cavity when filled and the movements by which evacuation is accomplished when the sound is removed. The technique of the method is described and brief notes given of 21 pathological cases accompanied by pyelograms. It is a simple and harmless method which is of value in the diagnosis of pyelonephritis, calculosis, hydronephrosis, spasm of the pelvis and tumor and should be extensively used by the urologist. It is not a rival of pyelography but supplements it.

GLOGAUER, OTTO. On the appearance of the mediastinal organs in unilateral cirrhotic tuberculosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxv, 468–476.

Characteristic roentgen pictures are produced in unilateral cirrhotic tuberculosis as a result of mediastinal displacements. The trachea, the heart and the esophagus assume typical deformation and dislocation. In explaining the characteristic roentgen pictures on the basis of topographic relations of the mediastinal organs, the topography of the esophagus appears to be of special importance. Roentgenographically the contrasted esophagus (in cases of pure displacement of the heart to the left) is totally displaced to the left, and in mediastinal displacements to the left and upward it assumes the shape of an elongated z. Its course is not influenced so greatly in cases of right-sided cirrhosis. The first type of dislocation is caused by traction on the heart or on the trachea and the second by direct tension on the pleura. This was demonstrated by the autopsy findings of a case of left-sided cirrhotic pulmonary tuberculosis. Experiments on the phantom show that tension on the left main bronchus suffices to produce all the characteristic changes in the mediastinal shadow seen in the roentgenogram. This traction which is the result of the pull of the fibrosing left upper lobe transmitted to the trachea, produces a displacement of the esophagus to the left, a steep position and rotation of the heart with the apex forward, and hence the typical "steep form" of the heart shadow.

GOLDHAMER, KARL. On the roentgenographic representation of the atlas and the pars lateralis occipitis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 627–629.

The atlanto-occipital articulation and details in the adjacent areas rarely appear with sufficient clearness in the ordinary roentgenographic procedure. The author proposes a maxillary-occipital exposure of the skull which enables a clear roentgenological representation of the atlas and pars lateralis occipitis and possesses distinct advantages. In effect the new method projects the above-named structures into the light area of the maxillary sinus and the cavum oris, thus bringing them into view more satisfactorily than by the usual exposures.

This procedure is especially of use in cases of injury to this region in deformations and especially in those cases of basal impression in which as a result of projection of the base of the cerebellar fossa the usual exposures yield negative results. Another useful application of the method is in study of arthritic affections in this region.

GOTTLIEB, J., and STROKOFF, F. Roentgen diagnosis of diverticulum of the urinary bladder. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 574–578.

The operative therapy of diverticula of the urinary bladder has been finding increasing application during recent years, and as a result, an increasingly practical importance attaches to exact diagnosis. The object of the diagnosis is to describe as exactly as possible the size of the diverticula and their relations to neighboring structures. From this standpoint the results obtained by cystoscopy are inadequate; on the other hand, the results given by roentgenograms of the bladder filled with 10 per cent sodium bromide solution are more satisfactory.

The roentgenograms are taken in the three positions: (1) dorsoventral; (2) axial; (3) oblique. In some cases better results are obtained when the roentgenogram is taken after the insertion of opaque ureteral catheters into the diverticula. Upon introduction the catheters roll up in the diverticulum. Roentgenoscopy of the opaque filled bladder is equally valuable and may give information as to the pathogenesis of the diverticula. Three cases are briefly described and pictured.

GRIMM, HOMER W. Mediastinal teratoma. *Radiology*, May, 1927, viii, 438–439.

This is a case report of a teratoma in the intrapericardial region. The provisional diagnosis was "idiopathic hypertrophy of the heart." Anteroposterior and lateral films showed a large tumor which completely obliterated the outline of the heart and was located mostly in the anterior portion of the chest involving the mediastinum. The patient died and a thorough pathological examination was made at

autopsy, which will be reported in another journal.

Haas, Ludwig. Roentgenologically demonstrated lime deposits in conjunction with gout-like clinical symptoms. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 630–632.

Reports are given of 2 cases in which the clinical signs were quite characteristic of acute attacks of gout. In both cases roentgenological examination disclosed calcareous deposits at the level of the pisiform bone. In a third case there was clinically a lesion of the first interphalangeal joint. The roentgenogram showed only a calcareous grain in this joint but at the same time there was present an arch-like notch at the proximal phalanx which was characteristic of the gout tophus. It seems probable that the calcareous shadow is not due to a calcifying periostitis but is the result of the gout. It is known from older observations that the tophi in gout may contain in addition to urates also calcareous salts, sometimes in considerable quantities.

Hartung, Adolph. The diagnostic value of iodized oil in intra-thoracic lesions. *Radiology*, June, 1927, viii, 488–493.

The author points out the value of iodized oil in the following conditions: bronchiectasis, lung abscess, chronic suppurative processes in the lung, intrathoracic neoplasms, foreign bodies, pulmonary tuberculosis, chronic empyema, fistulae of the chest wall. Iodized oil is an ideal contrast medium for this purpose, and it is non-irritating, practically harmless and easily used. Positive findings obtained with it have definite diagnostic value.

Haudek, Martin. Remarks on the article of A. Fraenkel "Particular Diagnostic Results from the Study of Roentgenological Peristalsis of the Stomach." *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 505–514.

The author expresses serious doubts as to the suitability of cinematography in determining slight pathognomonic defects of motion. The possibility of detecting a localized deficiency in mobility of the wall by roentgenoscopy is considered entirely adequate and its findings are of more definite value than those possible in cinematography, since one is able to utilize different positions of the body and augmentation of peristalsis.

The reliability of the new ulcer symptoms: tachycardia with asthmatic disturbances and pre-peristalsis, is considered dubious in view of lack of confirmatory case reports and other considerations. The proposal to base a differential diagnosis between ulcer and carcinoma upon non-roentgenological examination instead of upon the well-established changes in contour of the stomach shadow is rejected.

Hearn, William P., and Clerf, Louis H. Post-operative massive collapse of the lung. *Ann. Surg.*, 1927, lxxxv, 54–60.

A report is given of the detailed bronchoscopic observations occurring in a child aged eight years, admitted for closure of a gastrostomy fistula. The postoperative recovery seemed uneventful but in a short time massive collapse of the left lung occurred.

Bronchoscopy revealed a large quantity of very thick tenacious yellow secretion in the trachea and left bronchus. Ten c.c. of secretion was removed with a specimen collector. The mucosa of the left bronchus and its subdivisions was found very inflammatory. The right bronchus seemed normal and was free from secretion. When first observed the lumen of the left bronchus was completely occluded by the secretion and no air was seen to enter the left lung. The bronchial walls did not move with respiratory movements. Following aspiration of the secretion the bronchial lumen was seen to dilate and contract with inspiration and expiration. After removal of the obstruction there was a return of the bronchial movements and by physical examination, roentgenoscopic observation and roentgenographic studies, it was conclusively shown that air again entered the lung tissue, the diaphragm resumed its function and the lung expanded. With the recurrence of bronchial obstruction the lung again collapsed only to resume its function when the obstruction was removed. This observation was made seven times in one case and is supported by evidence secured by physical examination, by roentgen-ray studies and by bronchoscopy.

It is suggested that early bronchoscopic investigation should be carried out in post-operative pulmonary collapse if the surgeon and internist consider it a safe procedure in the particular case.

Hedblom, Carl A., and Head, Jerome R. On the use of lipiodol in relation to thoracic surgery. *Ann. Surg.*, 1927, lxxxv, 194–206.

In bronchiectasis without much fibrosis the roentgenogram may fail to demonstrate the lesion. A pulmonary abscess cavity may be indistinguishable from surrounding pneumonitis or sclerosis. A solitary multilocular or multiple abscess of the lung or an empyema cavity may be entirely masked by a diffuse thickening of the pleura. The nature, extent

and relation of the fistulous opening in the chest wall are perhaps never demonstrable on the ordinary roentgenogram. In the study of such conditions the use of a safe and practical contrast medium similar in principle to those used in the roentgenological examination of the gastrointestinal and genito-urinary tracts should therefore be of the greatest value. The employment of lipiodol answers the requirements.

Brief descriptions are given of the use of lipiodol in different types of thoracic diseases: bronchiectasis, lung abscess, empyema, fistula of the chest wall, pulmonary tuberculosis, intrathoracic neoplasms and estimating the results of operation.

The authors' experience in a number of cases shows that lipiodol is harmless when injected into the lung. In some of the cases the oil had disappeared entirely in a week, while in others it was present in part after several months. The oil is expelled from abnormal pulmonary cavities more readily than from the terminal bronchi of the normal lung. In all the cases the pre-existent cough was either lessened or remained unchanged after the lipiodol injection. In none of the cases were any ill effects noted.

In interpreting the roentgenograms with lipiodol as contrast material there is a factor which will always have to be considered, namely, the picture varies with the amount of oil injected. If the patient coughs before the exposure, there results a rather characteristic marking.

HUBENY, M. J. Pain: Its value; its elusiveness. *J. Am. M. Ass.*, July 23, 1927, lxxxix, 271–272.

All roentgenologists have seen many cases in which pain or the absence of pain assisted in either proving or disproving a clinical diagnosis, which syndrome could be explained by a thorough roentgenological examination. It is well known that the severity, persistence, or total absence of pain is often at variance with the magnitude of the disease. Roentgen-ray diagnosis often assists in explaining the cause of pain because it reduces the intangible to the tangible.

Often a gastrointestinal examination is made with negative result. However, should one observe a dilated aorta, an exploratory operation can be averted by entertaining the possibility of a diabetic gastric crisis.

A cough or a so-called nasal catarrh should be given roentgenographic consideration from the standpoint of a sinus infection or some pulmonary lesion. The possibility of silent infections should be kept in mind.

Fractures present an interesting phase because some serious cases occur with little or no pain. It is unwise to examine the skull roentgenographically over the scalp wound area alone because of the well-known contra-coup fractures which happen so frequently.

IDE, CHARLES E. Correlation of X-ray plates, clinical findings and blood pressure readings in a series of 300 cases. *Radiology*, April, 1927, viii, 307–310.

Out of a group of over 2,700 health examinations there were 300 roentgenograms of the chest made and these were studied with special reference to blood pressure. These were grouped as follows: (1) those having pulse rate of about 90; (2) those with evidence of dyspnea on exertion; (3) those with high systolic or diastolic blood pressure, and (4) those with short or long pulse pressure. A group twenty to thirty years of age having systolic blood pressure approaching 100 or lower, showed mottling or scar tissue in the upper lobes in roentgenograms. Pulmonary tuberculosis differs clinically and roentgenologically according to age. On physical examination any cardiac dullness to the left can easily be substantiated by a roentgenogram. There is a close relation between the condition of the heart and disease of the lungs. The correlation of roentgen findings and clinical signs is of much importance in health examinations and will be found useful to an increasingly greater degree. Lesions of the lungs affect cardiac shadow and blood pressure and a study of all these factors aid in correct diagnosis.

JOHNSON, CLAYTON R. Mensuration and localization by means of the roentgen ray. *Radiology*, June, 1927, viii, 518–521.

A simple method for mensuration and localization by means of the roentgen ray is given in detail. This is less complicated than the method previously described by the author. It is rapid and accurate; as applied to pelvimetry, all the desired diameters of the pelvis may be determined in about ten minutes. Foreign bodies may be easily localized with relation to surrounding anatomical landmarks. The details of the special apparatus and the methods employed cannot be given here. There are three photographs of the apparatus and proper descriptions to illustrate the method of use.

KAESS, F. W. The roentgen diagnosis of congenital atresia of the esophagus. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 481–483.

The roentgen examination can yield valuable

information in congenital malformation of the esophagus, as illustrated in a recent case of atresia of the esophagus. The child three days after birth was referred to the surgical clinic for the production of a nutritional fistula, owing to complete stenosis of the esophagus. Milk administered by mouth had been promptly vomited and gave rise to symptoms of strangulation. Roentgen examination of the opaque filled esophagus showed stoppage about 2 fingers breadth above the bifurcation. In addition some of the contrast material in finely divided form could be recognized in the bronchial branchings. In addition to these findings, there was a large accumulation of air in the stomach and upper small intestines. Autopsy confirmed the roentgenographic findings and disclosed a narrow fistula between the esophagus and trachea.

KAHN, MAX, and COHN, L. CLARENCE. Diagnosis and treatment of bone lesions of the hand and foot, with special reference to bone tumors. *Radiology*, April, 1927, viii, 289–291.

This is a summary of a study of 89 cases of bone lesions of the hands and feet. It is interesting to note that of 66 of the cases in which the age was recorded, 42 occurred before the age of thirty and there were almost twice as many males as females. Nearly one-half of the lesions involved the tarsal bones. Of the remainder about one-half involved the phalanges of the hands and feet and the other half the metacarpals and metatarsals. The cases fall in the following groups: 28 exostosis, 11 chondroma, 8 giant-cell tumor, 6 myxoma, 4 osteitis fibrosa, 2 sarcoma, 2 osteomyelitis, 2 epithelial lined cyst, 1 hemangioma, and 1 ossifying hematoma. The last four types listed have no characteristic roentgen appearance, with the exception of osteomyelitis, and even this is difficult to recognize in the carpals and tarsals. It was noted that sarcoma rarely involved the bones below the wrist and ankle. Leaving out the exostosis, the most common tumor of the hand and foot is chondroma, the next most frequent is giant-cell tumor, then myxoma, next osteitis fibrosa, and sarcoma the rarest. It is practically impossible to make a roentgen diagnosis of chondroma, myxoma, giant-cell tumor and osteitis fibrosa. The surgeon must be prepared to use the cautery in case the tumor proves to be a myxoma. This form of tumor is particularly resistant to roentgen-ray treatment and curettement followed by thermal and chemical cauterization is the method to be used in such cases. Myxoma is more frequent in the hands and feet than in other bones.

KEARNS, WALTER M. Pyelography in renal tuberculosis. *Radiology*, Aug., 1927, ix, 109–124.

In a comprehensive literature review, it is shown that there is wide divergence of opinion as to the desirability of making pyelograms of the tuberculous kidney, although it is generally found useful in demonstrating congenital anomalies and dystopias, displacements and torsions, ureteral obstructions, tumors, etc. Some authorities reserve the pyelogram for those cases of tuberculosis in which the diagnosis by other means is doubtful, and they refrain from injecting the kidneys with advanced cavernous disease. The author does not use the pyelogram in tuberculosis of the kidney. However, pyelographic changes have been studied by injection of the freshly excised kidney with 20 per cent sodium iodide solution. Many illustrations are given to show the usefulness of this method; the pictures do not differ from those obtained in the living, except that better definition is obtained in the operative specimens.

The objections to routine pyelography in renal tuberculosis are its needlessness, unreliability and danger. The bacteriological diagnosis is quite satisfactory and positive in a large number of cases; the direct smear or guinea pig test is of real pathognomonic importance. Cabot reports more than 95 per cent positive findings by bacteriological tests. Direct smear of the sediment is the preferable method because it is simple and rapid. If the urine examination is negative, the pyelogram would be useless except in rare cases. Pyuria in which no organisms can be cultured is considered presumptive evidence of tuberculosis, if other examinations give evidences of tuberculosis. The pyelogram gives no more reliable information than these tests, and it is not possible to tell definitely the character of the changes which have taken place, nor indicate exactly the surgical procedures which must be followed. Injection of the kidneys, the seat of acute infections, is not practiced in modern urology, because of the danger to the patient. Not only is there danger of dissemination, but the patient should not be subjected to the shock of such injections.

The author has submitted excellent pyelograms and other illustrations to show the extent and character of changes brought about by renal tuberculosis.

KELLOGG, EDWARD L. and KELLOGG, WILLIAM A. Chronic duodenal stasis. *Radiology*, July, 1927, ix, 23–38.

The authors first discuss etiology of chronic duodenal stasis and present excellent drawings

to illustrate the various contributing factors. Physical signs are also given, together with treatment of the different forms. The roentgenologic study of the first and second portions of the duodenum usually makes diagnosis clear, but in mesenteric compression a negative report is often obtained. Duodenal stasis exists as one of the manifestations of enteroptosis and also as a pathologic entity due to mechanical conditions. Symptoms are modified by the relation of the obstruction to the ampulla of Vater. Duodenal bands produce symptoms when contracted by inflammation or when dragged upon by the prolapsed bowel. Retroperitoneal adhesions at the inferior angle may result from duodenitis. Abnormalities of shape are due in part to rotation of the duodenum. Prolapse of the small intestine into the pelvis and compression of the jejunum at the pelvic brim give symptoms of stasis. Arterial compression occurring in hyper-fixation of the hepatic flexure is also a cause of obstruction. Compression of the third portion is largely dependent upon the anatomical arrangement of the superior mesenteric artery and its branches. Glycosuria and possibly diabetes is often associated with duodenal pathology. The writers draw from an additional group of 82 cases in discussing these conditions.

KING, J. CASH. Thymic enlargement in children: its diagnosis and treatment. *Radiology*, Aug., 1927, ix, 148–152.

The importance of roentgen examination in children showing symptoms of thymic enlargement is emphasized. The usual symptoms are noted, but since none of them are pathognomonic of this condition, final diagnosis depends on roentgen findings. Deaths from this cause shortly after birth can often be avoided by quick recourse to roentgen examination and with proper treatment the condition can be entirely controlled. The importance of careful and expert technique cannot be over-emphasized. The roentgen examination for enlarged thymus should include the entire chest from different positions to eliminate heart and lung pathology. Roentgen rays and radium are the only means of treatment of enlarged thymus. It is necessary to use sufficiently high kilovoltage, with proper filtration, to get a dose at a depth of from 3 to 4 cm. that is equal to 50 per cent of the skin dose. The author uses the divided dosage as follows: 120 kv., 4 mm. Al, 4 ma., 15 in. distance 3 to 4 min. time. This dose is repeated daily until three treatments have been given. Rapid improvement follows such treatment and complete reduction of the thymus and symptoms follows within a short time.

Two case reports are given to show the need for thorough roentgen examination and early treatment. One case, a new-born baby, showed cyanotic symptoms and the roentgenogram showed enlarged thymus. Treatment with the roentgen ray was followed by improvement during the day and following night, but the attacks recurred next day. Four successive treatments during the next four days were followed by very pronounced improvement. Two weeks later two more treatments were given, after which a roentgenogram showed disappearance of the enlarged thymus. The second case was that of a four weeks old baby which showed clinical symptoms of pyloric stenosis. Roentgen examination of the intestinal tract showed spasm of the pylorus, while a plate of the chest showed enlarged thymus. Roentgen treatment for thymic enlargement gave complete relief from symptoms and after one week the patient was discharged from the hospital and has had no further attacks. Careful roentgen examination of the chest for enlarged thymus should be a routine procedure where symptoms are even suggestive of this condition.

KLOIBER, HANS. Source of error in the roentgenogram of the spine. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 451–454.

The sagittal picture of the upper thoracic spine in a patient with pronounced kyphosis showed at two different examinations a narrowing of the third thoracic vertebra. This finding, taken in connection with the general condition of the patient, was regarded as a sign of pathology of the spine. However, an oblique roentgenogram showed the third thoracic vertebra to be of normal height and structure. A consideration of the anatomy of the case disclosed the explanation for this source of error. The central projection, the pronounced kyphosis and the employment of an anterior posterior view all combined to give the picture of an apparent narrowing of the vertebra. In the case of a pronounced kyphosis it is not always possible to have the spine approximately parallel to the roentgen film and it therefore becomes necessary to bring the suspected region close to the film with the central ray directed upon it. The result is that the vertebrae adjacent to the suspected section become distorted upon the roentgenogram. This difficulty and source of error may be easily avoided by securing lateral or oblique roentgenograms.

KNIPFER, A. Roentgen diagnosis of bilharziasis of the bladder and ureter. *Radiol. med.*, Dec., 1927, xiv, 1071–1076.

Bilharziasis of the bladder and ureter is endemic in Egypt and other tropical countries. Its clinical symptoms are often new to the European physician who should know it and think of it when examining patients from tropical countries. Several roentgen pictures which in Europe are generally interpreted as being due to urinary calculosis may be due to calcification of bilharzia or to a calculus implanted or superimposed on a zone affected by bilharziasis. The differential diagnosis between calculosis and calcification in bilharziasis, which is always important when operation is under consideration, is treated chiefly from the point of view of roentgen examination.

An interesting case is described in which there was a calculus of the kidney pelvis implanted above an infiltrated zone in the upper part of the ureter. According to the author, the diagnosis of such infiltrations from bilharziasis can be made from the elongation and dilatation of the ureter and the character of the shadow which, unlike that of a calculus of the ureter, is tubular, that is, more intense along the walls; the shadow is blurred at the lower edge, is sometimes branching and is several centimeters long.

Another case was in an European child who had recently come to Egypt so that bilharziasis seemed very improbable. The roentgenogram, however, showed the changes in the bladder wall that are typical of calcification from bilharziasis. The author emphasizes the fact that individuals who have only passed a short time in a tropical country may contract bilharziasis and on their return home may present a picture simulating calculus, so it is important for the physician to think of this disease in order to avoid errors in diagnosis.

KOENIG, EDWARD C. X-Ray assistance in solving genito-urinary problems. *Radiology*, Aug., 1927, ix, 104–108.

The author shows by means of roentgenograms that characteristic shadows of the various pathologic conditions may be given, yet he contends that the urologic findings should be in accord before the urologist makes his final diagnosis. Cystoscopic examination, kidney function tests, chemical and bacteriological examinations, together with roentgenograms will give the urologist information by means of which he can feel quite certain of the condition of the urinary tract. The author then outlines conditions which illustrate the important part which the roentgenogram may play in such diagnoses. Symptomatology is of course an important part of each diagnosis. The illustrations include pyelogram of cystic kidney, double ureter, diverticulum of bladder, hydronephrosis, with normal pyelogram of opposite kidney, kink of ureter just beyond pelvis of kidney, strictures of ureter and opaque catherer coiled in diverticulum of ureter. These are given by way of demonstrating their value in studying pathologic conditions of the urinary tract.

KRÖMEKE, FRANZ. Etiology and clinical symptoms of eventration of the diaphragm. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 484–492.

For historical reasons, the author proposes returning to the old name: eventratio diaphragmatica. The clinical diagnosis of the condition without a previous roentgenoscopic examination is not always a simple matter. The patients were usually referred with a diagnosis of a left-sided exudative pleuritis, and in one case a premature puncture resulted in death of the patient. In most cases the nature of the disease may be determined quite definitely by roentgen examination. The main problem in differential diagnosis is the exclusion of diaphragmatic hernias. The fact that most of the hernias are of traumatic origin, while diaphragmatic eventration is usually congenital suggests the need for careful anamnesis. Brief descriptions are given of 9 cases observed by the author and emphasis is placed upon the importance of the frontal roentgenoscopy in the diagnosis of an intradiaphragmatic stomach. In one case there was eventration with partial ballooning of the median portion of the diaphragm as a result of tuberculosis originating in the hilum. In this type of case the Freud-Horner angle is not characteristic of diaphragmatic hernia.

LAPENNA, M. Mechanism of peristalsis of the stomach. *Radiol. med.*, Jan., 1928, xv, 1–11.

The author worked out the mechanism of stomach peristalsis by examining 100 patients roentgenoscopically and superimposing the sketches. Twenty of these sketches are reproduced in the article.

He found that the peristaltic movement not only does not stop in localized or general spasms (pylorospasm or gastrospasm) but it even changes the depth and position of the spasms as if it were the peristalsis itself that caused a spasm at some point where there was a slight change in muscle tonus.

Peristalsis, the depth of which varies a great deal in normal and pathological conditions, does not stop unless there is an organic lesion. This has been known for a long time but it is

particularly important now, especially in the diagnosis of simple, non-callous ulcer, that is to say, an ulcer which does not present the characteristic symptom of niche.

The intrinsic nerve mechanism of the stomach is located in the pre-antral region; it regulates peristalsis. The peristaltic lines of the body normally converge there and bring about a functional separation between the body of the stomach and the antrum-pylorus. Organic lesions of the stomach, and particularly those of the duodenum, cause an arrhythmia in gastric peristalsis as a result, presumably, of changes in the centers which regulate rhythm. The peristalsis of the antrum may act autonomously and under certain pathological conditions it seems that that of the body may also.

LEWIN, PHILIP, and JENKINSON, EDWARD L. Bone diseases in infants and children. *Radiology*, May, 1927, viii, 409–415.

The authors give a very good review of the present information on the effect of various diseases on the bones of infants and children. The effect of rickets is characteristic, the ends of the bones being attacked, mostly near the epiphyseal line. The shaft of the bones are soft and curved, due to lack of calcium. Adolescent rickets is expected to be a revival of infantile disease which has been dormant for a number of years. Due to improved dietary knowledge, even among the poor, scurvy has become rare. The characteristic changes occur behind the diaphyseal line. The lesions resulting from lues, tuberculosis, Legg's disease, osteomyelitis, Still's disease and coccidioidal granuloma are reviewed, the authors confirming observations made by others and most of which are well known. Incidents are cited which, in the experience of the authors, give confirmation to descriptions of these lesions which have been previously described fully.

MACCARTY, WILLIAM CARPENTER. A key to diagnosis and prognosis of neoplastic lesions of bones. *Radiology*, April, 1927, viii, 277–281.

The author first calls attention to the confusion concerning neoplastic lesions of bones and gives the following reasons: multiplicity of meaningless synonymous names for lesions; poor, antiquated and inadequate methods of histologic study, such as fixation and embedding, both of which are inferior to fresh tissue study; lack of intimate co-operation between surgeon and pathologist; and conservatism in adherence to traditional terminology and classification. He then classifies bone lesions as: those visible or palpable which follow injury without fracture or infection; small lesions which are not easily felt, but which, due to pain, discomfort or reduction of function, show signs of infection; lesions which are associated with symptoms of low-grade infections, which in the roentgenogram show mottled, irregular shadows with destruction of bone; and lesions which are a part of bone or cartilage or a definite outgrowth of either. All these conditions can easily be seen by means of the roentgenogram, but a correct diagnosis and prognosis cannot always be made by this means. The important problem is, are the conditions inflammatory, or benign or malignant neoplasms; the treatment depends on a proper diagnosis of which condition is present. The majority of cases are readily determined, but the others are doubtful by physical examination, clinical history and roentgenograms alone. In doubtful cases the tumor is incised and specimen examined in the fresh unfixed condition, when the arrangement of cells and the cells themselves are studied. The author gives two diagrams by means of which the pathologist will be materially aided in his diagnosis and prognosis. The diagrams give graphically the evolution of tumor cells from the fibroblasts and endothelioblasts. By observing the type of cells present in the incised tumor and studying the evolution of these cells by means of these charts, it is possible to tell whether the condition in benign, malignant or very malignant. A description of these cells and their significance is given. Pathologically neoplasms may be classified as follows: (1) osteo-, fibro-, chondro-, and endothelio-textomas; (2) osteo-, fibro-, chondro-, endothelio-, erythro-, and leuko-textoblastomas, and (3) pro-textoblastomas. The most common, in the author's experience, is the texto-blastoma composed of osteoblastic, fibroblastic and chondro-blastic cells in combination.

Immediate cytologic study must be made a clinical procedure if correct prognostic diagnosis of many neoplasms of bones is to be accomplished with any degree of certainty. Because of the greater intelligence of the layman, these smaller lesions come to the attention of the surgeon and bring greater difficulty in diagnosis, bringing increased pressure to bear on the cytologist for more accurate histologic diagnosis.

MAIER, R. J. Diagnosis of anencephalus before birth. *Radiology*, Aug., 1927, ix. 166–168.

Two case reports are given in which the

roentgenogram was used in diagnosing anencephalus before birth. This is the only sure means of such diagnosis and should be used because in case of anencephalus the pregnancies can be terminated. It is possible to make such diagnoses by means of roentgenograms as early as the fourth or fifth month.

MANGES, WILLIS F., and HAWLEY, S. J. Roentgen-ray observations in asthma. *J. Am. M. Ass.*, Sept. 10, lxxxix, 870–872.

The changes found in the chests of 157 patients with asthma showed the following distribution: General peribronchial thickening occurred in 27 per cent; chronic lower lobe infection in 23 per cent; tuberculosis in 18 per cent; thickened root structures in 12 per cent; enlarged heart in 3 per cent; emphysema in 1 per cent; no changes in 16 per cent. Subsequent studies have revealed cases that are difficult to classify because two or more changes are involved.

Recent investigation of the records of 193 consecutive cases of foreign bodies in air passages observed in Dr. Jackson's clinic at Jefferson Hospital, Philadelphia, revealed 155 children in the group, 142 showing diagnostic foreign body histories, 13 without diagnostic foreign body histories and 6 diagnosed asthma at some time. These 6 cases are cited briefly. It must be evident that foreign bodies in the air passages are sometimes overlooked because of the clinical resemblance of the symptom-complex to that of asthma. This is particularly true in children. It is also true that foreign body may be overlooked for a number of years so that a foreign body aspirated in childhood may produce a chronic lower lobe infection even into adult life without having been diagnosed as such.

Infection of the upper air passages is a very frequent complication and the authors believe it is a very important factor in the etiology of asthma. It seems certain that a very large percentage of cases with chronic asthma have also chronic infectious diseases of the accessory sinuses.

MCCRAE, THOMAS, FUNK, ELMER H., and JACKSON, CHEVALIER. Primary carcinoma of the bronchi. *J. Am. M. Ass.*, Oct. 1, 1927, lxxxix, 1140–1148.

There is evidence suggesting that carcinoma of the lung, which in the great majority of cases originates in a bronchus, is increasing in frequency. These bronchial tumors appear to have a relatively low malignancy and hence give hope that early diagnosis and intensive roentgen-ray therapy may be effectual in at least prolonging life. Early diagnosis can be reached if the possibility of bronchial neoplasm is considered and careful studies are made. The early symptoms are usually those of bronchial irritation and the early signs are those of bronchial obstruction. By bronchoscopy a positive diagnosis can almost always be made promptly and proper treatment instituted. Several cases are briefly described.

MEEK, WALTER J. The use of X-rays in the study of physiology. *Radiology*, May, 1927, viii, 369–373.

Three years after the discovery of the roentgen ray, it was used by Cannon in studying the motor mechanism of the alimentary tract. As an aid in teaching physiology, however, the roentgen ray has not been used very extensively. With the co-operation of the roentgen ray, it is possible to study body functions as they are in the normal as well as the abnormal without interference by artificial means, such as operation and dissection under anesthesia. The author has employed this means of making studies of heart action under normal and abnormal conditions. The reaction of the heart to hemorrhage, the effect of plethora on the diastolic size of the heart, the relation of venous pressure and pulse rate to cardiac size and output, and a study of the pericardium were made possible in this way. All of these studies were greatly simplified and more definite information gained by the aid of roentgenograms. The author then describes these various physiological reactions which have both a scientific and practical value.

MEYERDING, HENRY W. Exostosis. *Radiology*, April, 1927, viii, 282–288.

The roentgenologist can accurately diagnose exostoses with properly prepared films and can describe the site, size and apparent structure of the tumor, its relation to surrounding tissue and whether it is single or multiple. For convenience the author has rearranged the classification of such tumors so that it leads from the inflammatory and benign to the malignant groups, ten groups in all. The present study was conducted on 265 cases of exostosis in 232 patients who were operated on at the Mayo Clinic. The diagnoses were verified pathologically. The youngest patient was five years old and the oldest sixty-four, the average being 26.9 years. Heredity and metabolic disturbances in childhood are of much more importance than trauma in explaining the etiology of these tumors. The age incidence is very similar to sarcoma of the long bones;

79.7 per cent of the exostoses and 75 per cent of sarcomas occurred between the ages of eleven and forty. The usual symptoms are painless swelling or deformity, but sometimes this is accompanied by a dull, localized pain. The exostoses in this series of cases were widely distributed: 65 in the femur, 34 in the tibia, 30 in the humerus, 26 in the foot, 17 in the fibula, 16 in the scapula, 14 in the ilium, 9 in the superior maxilla, 9 in the clavicle, 7 in the mandible, 6 in the radius, 6 in the finger, 5 in the rib, 5 in the ulna, 4 in the carpus, 4 in the os pubis, 2 in the frontal bone, 2 in the vertebra, 2 in the ischium, one in the patella and one in the orbit. A diagram is given showing the positions of these and the number in each position. Whenever the roentgenologist made a diagnosis of exostosis, the opinion was proved to be correct.

The roentgenologic characteristics of exostosis are as follows: (1) the cortical point of origin is usually in the diaphysis near the epiphyseal line and is most common in the lower end of the femur and the upper end of the tibia and femur; (2) the base varies from a broad pedicle to a narrow one and the tumor from a slight bony projection to a pedunculated mass of varying size; (3) the cortex of the bone may appear continuous with the tumor; (4) a cartilaginous cap is common and often presents a cauliflower-like appearance; (5) a bursa covers the well-formed tumors; (6) they may occur as local and general tumors and may present many deformities; (7) there is not invasion, but rather penetration of tissue; bone is not absorbed except as the tumor causes pressure on the neighboring bony structures; (9) the periosteum is expanded over the tumor, and (10) growth is usually away from the joint. The treatment of these tumors is surgical, but their presence is not always an indication for operation. The author prefers complete excision of the bursa, capsule, cartilage, and bone intact, with cautery to the exposed bone and close layer suture. The prognosis is good in single types when the peri-osseous structures are not damaged too much. In this series recurrence was noted in 10 per cent of the cases. There was no surgical mortality.

The author gives abstracts of 6 illustrative cases with roentgenograms. The reliability of this means of diagnosis is clearly evident and offers a very accurate means of guiding the surgeon in operation also. The roentgenograms submitted for illustration are very clear and show to a marked degree the exact location, size, contour, etc., of the tumors described in the case reports given.

Mezzari, A. The value of Shenton's sign in the roentgen diagnosis of congenital luxation of the hip in early childhood. *Radiol. med.*, Jan., 1928, xv, 13–16.

The usual signs for demonstrating congenital luxation of the hip are very hard to demonstrate in young infants; therefore the author calls attention to the value of Shenton's sign. Shenton found that in a hip that is well centered a prolongation of the upper border of the obturator foramen exactly joins a line passing through the lower margin of the neck of the femur, describing a segment of a circle which is called Shenton's cervico-obturator line. When the normal relation of the bones is disturbed this line is interrupted. It has been called a positive Shenton's sign when the line is interrupted by upward displacement of the proximal end of the femur and negative when the displacement is downward. But the author thinks any interruption should be called a positive Shenton's sign and the word downward added if the displacement is in that direction. Downward displacement is rare and generally due to trauma.

In the cases of luxation of the hip in young infants treated by the author the sign was always positive. The roentgenogram must be taken with an absolutely frontal position of the pelvis.

In coxa vara congenita which may be confused with congenital luxation of the hip the line is enlarged but not interrupted. It may be interrupted in luxation of the hip from suppuration or tuberculosis but the differentiation can be made in these cases by the history and course of the disease and the fact that the roentgenogram shows signs of a destructive process.

Mills, Harlan P., and Watkins, W. Warner. Localization of foreign bodies in or about the eye. *Radiology*, April, 1927, viii, 336–357.

A large number of case reports are summarized in which the roentgenogram was used for localizing foreign bodies in and about the eye. Sweet's chart was employed and roentgenograms and charts of representative cases are given. The use of this means of locating foreign bodies in the eye makes possible quick and accurate treatment which in a great many cases has resulted in sight being saved. Some of the most interesting cases are reported in more detail, but all of the 146 cases are tabulated with brief statement of cause of injury, location of foreign body, treatment used and result. The importance of this systematic procedure in all cases of injury to the eyes is

evident and results in more accurate and more successful treatment.

Moore, Alexander B. Benign tumors of the stomach from the roentgenologic point of view. *J. Am. M. Ass.*, July 30, 1927, lxxxix, 368–370.

A benign gastric tumor usually produces a filling defect which is centrally situated and clearly circumscribed. It does not destroy the rougae, interfere with peristalsis or obstruct the pylorus unless seated in the antrum; it does not cause contraction or spasm of the stomach. While these signs are reasonably diagnostic, they are not absolutely pathognomonic of benignancy, for pedunculated growths may be primarily or secondarily malignant.

Exogastric benign tumors usually either by pressure or traction produce deformity of the gastric shadow which is likely to be misinterpreted as indicating cancer or ulcer, although exceptionally the fact that the lesion is extraventricular can be determined. Endogastric benign tumors have rather striking roentgenological features which should make their diagnosis possible in a high percentage of cases. Most conspicuous among the signs is the filling defect which is generally central rather than marginal, although it may be near the curvature. It is smoothly and sharply contoured as a rule, and is commonly rounded or oval. Occasionally a large tumor will show minor irregularities and a compound lobulated tumor will produce a lobulated shadow, but the individual lobules are evenly rounded. In most cases approximation of the gastric walls by manual pressure during the screen examination is necessary to bring out fully the contours of these tumors.

The outline of the gastric shadow is commonly preserved in the region of the internal defect, although it may be faint or made up of short broken lines. This is especially true of pedunculated tumors, and the majority of benign tumors are pedunculated. Mural and broadly sessile tumors, or numerous thickly set polyps, may exclude the barium from their base and produce a marginal defect. An almost unvarying characteristic of benign tumors, regardless of size or number, is that they do not lessen the size of the stomach. They may diminish capacity but they do not cause contraction or spasm.

Moore, Alexander B., and Vinson, Porter P. Cardiospasm, with kinking of the esophagus from kyphosis. *Radiology*, July, 1927, ix, 73–74.

A report is given of a man, aged sixty-five, who for six years had experienced a sense of obstruction in the median-esophageal region to passage of any type of food. Food eaten two or three days previously was regurgitated. General examination was negative, except for considerable kyphosis. Roentgen examination showed wide dilatation of the esophagus and obstruction of the barium meal at the cardia. When the cardia was stretched with a hydrostatic dilator complete relief from dysphagia resulted.

Morton, Charles Bruce. Observations on peptic ulcer. *Ann. Surg.*, 1927, lxxxv, 207–238.

The following aspects of the problem are discussed: (1) A method of producing chronic gastric ulcer; (2) a roentgenological study of experimental chronic ulcer, and (3) healing of experimental peptic ulcer after gastroenterostomy. The method for producing experimental chronic gastric ulcer was to produce acute lesions in the stomach and then to perform surgical duodenal drainage after the method of Mann and Williamson. The inherent power of the normal stomach to heal was verified, and jejunal ulcers of subacute and chronic types occurred in all the experiments where the operation for surgical duodenal drainage was performed. An analysis of the conditions present and the factors operating emphasizes the importance of the chemical and mechanical factors in the etiology of chronic peptic ulcer.

The results of the roentgenological study of experimental chronic ulcer in dogs is summarized as follows: Twelve normal dogs were given opaque meals after which roentgenologic examinations of the gastrointestinal tract were made. The findings were similar to those in human subjects. Following the study of the normal tract, 6 of the dogs were studied for ulcer formation following surgical duodenal drainage. Ulcers developed in all 6 dogs. Three were typical of the chronic type with deep craters detectable roentgenographically. Two were subacute lesions suspected at roentgenoscopic examination but not definitely shown in the roentgenograms. One was an acute ulcer and apparently developed and perforated suddenly after the last roentgen examination. In one of the chronic ulcers, the healing process following gastroenterostomy was observed. These findings demonstrate the feasibility of roentgenological study of experimental peptic ulcer. So far as could be determined motor changes of the gastric musculature could not be detected as etiological factors in the production of these ulcers.

Typical chronic peptic ulcers of the jejunum produced experimentally in 9 dogs were studied to determine the healing process. The ulcers were carefully measured at exploratory laparotomy, and gastroenterostomy designed to empty the greater part of the gastric contents through the new stoma was then performed. At necropsy performed at various intervals evidence of healing was present in all of the ulcers. In two experiments the ulcers healed entirely and in one experiment a deep chronic ulcer 1 cm. in diameter and 0.5 cm. in depth healed almost completely in sixteen days following gastroenterostomy. The rate of healing in the ulcers was directly proportional to the size and chronicity of the ulcer and to the length of time after gastroenterostomy. Coincident with the healing of the original ulcers new ulcers formed in the efferent loops of the gastroenteric anastomosis. The acid-alkali imbalance following surgical duodenal drainage and the force with which the contents emptying from the stomach impinged directly on a relatively circumscribed area of the intestinal wall appeared to have an important bearing on the formation of chronic ulcers after surgical duodenal drainage. The healing of these ulcers with the coincidental formation of new ulcers in the efferent loop was brought about by gastroenterostomy and the consequent alteration in the factors responsible for ulceration.

NAHMMACHER, H. Differential diagnostic considerations in the roentgenographic representation of the genital system. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 579–587.

It is predicted that it will be only a short time before there will be general recognition of the diagnostic value of uterosalpingography to the gynecologist. There are numerous cases in which the usual roentgenographic technique is unable to establish a differential diagnosis between a uterine and adnexal tumor and in these cases uterosalpingography becomes an indispensable aid. Not only does the latter give typical roentgen pictures which indicate the diagnosis, but it is also able to establish the diagnosis. For this purpose it is quite essential to compare the roentgen pictures with preparations obtained after operation and to study the anatomical relations.

For the production of the uterogram the author employs 40 per cent iodipin as the contrast material. The uterine cavity receives 3 to 5 c.c. of oil, depending on its capacity, introduced at moderate pressure. After filling, the portio is closed off in order to prevent a too rapid discharge of the contrast material. Roentgenograms are taken at intervals of three, five, thirty, and sixty minutes, depending on the condition and extent of the disease. Preceding each roentgenogram the bladder and colon are thoroughly emptied. Probing is avoided because of its danger.

The cavity of the normal uterus shows a typical triangular shape, the base lying at the fundus. The capacity under normal conditions is about 3 c.c. The cervical canal in juvenile and atrophic uteri appears as a streak 1 to 2 mm. wide. In the uteri of pluripara the lumen is usually about 5 mm. wide. The contour of the cavity in the normal uterus is smooth, showing here and there a wavy outline due to contractions. More or less characteristic uterograms are obtained in cases of retroflexion, metritis, polypi, uterine and ovarian tumors, salpingitis and sterility.

The technique is entirely harmless if aseptic precautions are taken. Cases showing fresh signs of inflammation, fever, pregnancy or gonorrhea must be excluded. The presence of hemorrhage is not necessarily a contraindication to uterography. In the diagnosis of tumors of the uterus, the condition of the uterine cavity must be studied, and in cases of tumor of the ovary a study of the tubes is the basis of the diagnosis.

NESSA, N. J. A case of pneumocephalus. *Radiology*, July, 1927, ix, 74–75.

Pneumocephalus following injury to left side of head, frontal area, was observed by roentgenologic examination. After the wound had healed, a roentgenogram was made two months later showing complete absorption of the pneumocephalus. No definite fracture of the frontal sinus could be noted.

NICHOLS, B. H. Some observations from a roentgenological study of the aorta. *Radiology*, Aug., 1927, ix, 136–147.

Aortitis, while the most common disease of the aorta, is difficult to diagnose until a late stage has been reached and well-advanced aneurysm has been produced. A positive Wassermann test or a history of lues is important in the diagnosis of aortitis. The roentgenogram is the most reliable method of early diagnosis of aortitis or aneurysm, or for confirmation of the diagnosis and determination of the extent of the disease. Roentgenograms made in the posteroanterior position and in the second oblique and the lateral positions are most valuable. In aortitis the aortic shadow is increased in density by the diseased condition of the walls. Bulging or distention of the ascending aorta alone may

usually be considered as indicative of a syphilitic condition. Drawings illustrating the normal positions of the aorta are given, as well as roentgenograms of the normal in the four positions, and also examples of typical aortitis. In some cases it is desirable to inject lipiodol to determine the exact position of the tracheal walls. By comparing roentgenograms of aortitis with those of the normal aorta, considerable information can be obtained and early diagnosis accomplished in cases which could not be detected by other means.

NICOTRA, A. The anatomical and roentgen picture of Busi's kink of the second portion of the duodenum. *Radiol. med.*, Dec., 1927, xiv, 1099–1105.

On the basis of several cases seen and verified on operation, the author believes that kink of the second portion of the duodenum presents a characteristic picture which must not be confused with the picture of adhesions or with that of malformations brought about by pressure from outside the duodenum, for example, from cholecystitis or gas in the colon. From the results of experiments he maintains that kink of the second part of the duodenum is due to elongation from ptosis of the duodenum itself which at the point where the pancreatic duct and the hepatic duct empty, that is to say, at Vater's ampulla, is pulled upward and toward the midline by these ducts, as they are normal in length. He admits that it is true that malformations may be brought about in the duodenum as a result of external pressure or bands, but these are not the cause of the kink, but a complication of it.

O'CONOR, VINCENT J., and REMMERT, ARTHUR. The value of pyelo-ureterography as a diagnostic aid. *Radiology*, 1927, Aug. ix, 125–135.

After a careful study of a second of series of cases, comprising 356 in which pyelo-ureterograms were made, the authors conclude that this aid to diagnosis is only one of the urologic procedures necessary and should not be utilized except in conjunction with analytical, functional and bacteriologic data. In this study more careful observations were made of the complete ureteral outline and obstructions were noted which might ordinarily have been overlooked. Improvement in technique and a combination cystoscopic and roentgen-ray table allowed an easy comparison of the ureteral and pelvic outlines with the patient in both prone and erect positions. In this way it was possible to greatly aid in the diagnosis of congenital anomalies, variation in the normal, hydronephrosis, tuberculosis of the kidney and ureter, renal neoplasms, renal and ureteral calculi, ptosis of the kidney, ureteral obstruction (stricture) and differentiation of abdominal or retroperitoneal masses. No instance of anuria, local or general, or severe reaction of any kind resulted from the procedure of pyelo-ureterography in this series of cases. Representative roentgenograms are given to illustrate the conditions discussed. In conjunction with clinical history, cystoscopic findings, etc., in spite of the negative smears, the pyelogram made possible correct diagnoses in some cases of tuberculosis of the kidney and ureter. In 2 of these cases the diagnosis could not have been made without the pyelogram. The authors do not find bacteriologic tests entirely satisfactory in tuberculosis.

PALUGYAY, JOSEF. The etiology and roentgen diagnosis of changes in the tibial tuberosity classified as Schlatter-Osgood's disease. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 595–618.

The author reports 18 illustrative cases. From a study of these and of cases reported in the literature, it is concluded that manifold pathological changes may occur in the region of the apophysis of the tibia as in the other apophyses and epiphyses, and in the case of the changes which occur during the period of ossification there is by no means reason to assume a single etiological cause even though there may be considerable analogy in the subjective and clinical symptoms amongst the various cases. Accordingly there appears to be very little advantage in characterizing all these changes under the heading of Osgood-Schlatter's disease. The author proposes that this name be reserved only for those cases in which a definite traumatic etiology has been established, either as a result of single trauma or through repeated traumatic effects which have secondarily caused a partial fracture of the apophysis. On the other hand, in all cases in which the etiology is not due to trauma but to a break in continuity in the sense of a pathological fracture, the author suggests the name: pseudo-Schlatter's disease. However, all cases in which there is no break in continuity but inflammatory dyscrasic or neoplastic changes are present should not be included under Schlatter's disease.

The determination of the etiology as well as the diagnosis and differential diagnosis of diseases in the region of the ossifying apophysis of the tibia is difficult. The roentgen examination may give considerable aid provided the roentgenographic technique is satisfactory. One of the prerequisites, however, is an exact

knowledge of normal ossification, which must be considered in all cases. Another important detail is the repetition of the roentgenographic examination at long intervals.

PODESTÀ, V. The value of roentgen examination in appendicitis. *Radiol. med.*, Feb., 1928, xv, 129–169.

The author first discusses the anatomy, physiology, pathology and clinical examination of appendicitis and gives a brief review of what has been done in the way of roentgen examination of this disease. He criticizes the views of different authors on the subject and describes a large number of cases of his own, illustrated by roentgenograms and controlled by operative findings. He then gives his personal opinion in regard to the value of roentgen examination in the diagnosis of appendicitis and finds: that all permeable appendices whose lumen is in communication with the lumen of the cecum, and this is true of all normal appendices, can be injected with contrast medium; so if the examination is made with care and perfect technique any normal appendix can be studied by roentgenoscopy. In the permeable appendix there are roentgen signs which permit a conclusion as to anatomico-pathological lesions of the organ, such for example as fixation, deformity or less rapid emptying. If in spite of careful technique and repeated examination the appendix cannot be demonstrated it shows that it is not permeable. This fact accompanied by other indirect signs relating to the afferent loop of the ileum, the form and behavior of the cecum, etc., suggest inflammation of the appendix.

POKROVSKI, M. A case of primary infectious multilocular osteomyelitis, following a course resembling acute polyarthritis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 515–518.

A report is given of a case occurring in a boy aged sixteen. The disease affected several of the tubular bones and the petrous portion of the temporal bone. The affected bones showed similar roentgenological characters. Certain zones showed osteophytic processes and others destructive processes with formation of cavities and sequestra. The head of the right humerus showed a spontaneous fracture. In all the affected bones the process did not extend beyond the epiphyseal line. The joints in all cases were entirely normal on roentgenological examination; and adjoining bones revealed no changes of an atrophic nature. The absence of atrophy in the bony substance as well as location of the process exclusively in the diaphysis, with the exception of the right foot in which only the epiphysis of the fibula and external malleolus were affected, also the absence of any roentgenological changes in the joints, in the presence of massive osteophytic protuberances, made it quite clear that tuberculosis could be excluded. On the other hand, the roentgen pictures in all the involved areas were typical of osteomyelitis.

POLGÁR, FRANZ. On the displacement test for pleural effusions. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 618–622.

The author has been able to confirm the observations of Lenk concerning the free displacement of pleural effusions. Five illustrative cases are cited. The technique of examination has been improved by the following additional procedure. The patient, lying on his side, is examined roentgenoscopically with the horizontal roentgen beam. With the patient lying on the diseased side basal effusions assume a parietal position, a fact which permits the demonstration of minimal accumulations of fluid. When the patient is turned over on the healthy side the fluid settles in a paramediastinal position. In left-sided basal effusions, roentgenoscopy of the patient lying on his right side permits observation of the left boundary of the heart which would ordinarily be covered by the shadow of the fluid.

POTTS, WILLIS JOHN. The pathology of Charcot joints. *Ann. Surg.*, 1927, lxxxvi, 596–606.

Charcot, or neuropathic joints, present variable pathological pictures depending upon the time of observation. Because of the painless onset the condition is rarely seen before marked bone and joint pathology exists. Atrophic and hypertrophic changes in the articulating bones are described and as a result two kinds of arthropathy have been thought to exist. It is believed that this variation depends only upon the time of observation, and that all uncomplicated Charcot joints go through a definite and similar process of change in the following order: loss of protective joint sensibility; relaxation of the lateral ligaments with consequent minor marginal and major joint fractures; destruction of the articular cartilage and the intra-articular ligaments; sclerosis of the bone ends denuded of cartilage; periarticular and parosteal bone production; continued erosion and fracture of the articulating ends, and finally, when the bones no longer articulate or when invalidism occurs, atrophy. The process may stop at any

point or any of the above characteristics may predominate or be subordinated, depending upon the joint involved and the extent of the nerve injury.

The roentgenographic findings are of prime importance. The first deviations from the normal are: increase in the joint space due to ligament relaxation and wearing down of the articular cartilage; roughening of the joint margins due to marginal fractures; and joint lipping. Occasionally an intra-articular fracture is the first evidence of neuro-arthropathy. This feature occurred in a case briefly cited.

As the process advances sclerosis of the bone ends denuded of cartilage becomes demonstrable roentgenographically. Bony islands formed from loosened fragments appear in the joint and its capsule. The periarticular and parosteal bone is pathognomonic of the process. As sensation in and about the joint lessens and multiple fractures and erosions occur, complete disorganization follows and the joint becomes literally a bag of bones. The atrophy which appears late is the atrophy of disuse. The sclerosis mentioned occurs in upper extremity and hip arthropathy as well as elsewhere.

Proetz, Arthur W., and Ernst, Edwin C. Sinus mapping by the displacement method. *Radiology*, June, 1927, viii, 502–511.

A method called "displacement irrigation," originated by one of the authors, is recommended here for injection of iodized oils into the sinuses, especially the posterior sinuses. The head is so placed that the sinus in question shall be in relation to the nethermost portion of the nasal chamber, with its ostium upturned. The iodized oil is floated into this with a syringe and comes to rest on the face of the sinus wall, submerging the ostium. Gentle suction is applied to one nostril, the other being closed with the finger. The pharynx is sealed by holding the tongue in the "K" position. Air is displaced by suction with the oil; this process is repeated until the desired amount of oil is introduced, about fifteen to twenty alterations. This requires about one minute. When the patient assumes the erect position, the oil remains *in situ* indefinitely. Graphic drawings are given to illustrate the position and to show the progress of the injections. Roentgenograms of sinuses filled in this way are submitted to illustrate the results.

Lipiodol diluted with an equal volume of olive oil is the oil found best for this purpose. A special syringe is described and illustrated for this special purpose. Other positions may be used than that described here, such as the Granger, Pfahler, Hirtz, Waters, Pirie and Aspray angles.

Puschin, B. E. Generalized hyperplastic periostitis (Pierre-Marie-Bamberger's disease). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 540–546.

This rather rare and interesting condition, also described under the name of ostéoarthropathie hypertrophiante pneumique, is of unknown etiology and unexplained pathogenesis. The author reports 2 cases occurring in men aged thirty-nine and forty five years respectively, both suffering from chronic pulmonary tuberculosis. An extensive periostitis of a lamellar or tuberculated nature was found in all the long and short tubular bones, with the exception of the terminal and middle phalanges which, like the joints, remained free. Enlargements of the terminal phalanges and deformation of various joints were found to be exclusively due to increase in soft tissues and not to bone proliferation.

The diagnosis of this disease can be made only from the roentgenological examination. The roentgenograms are so typical that a diagnostic error is hardly possible. The changes in the region of the metatarsus and metacarpus may be regarded as definitely pathognomonic for generalized hyperplastic periostitis. When these particular changes are absent, attention should be paid to the legs and the forearms in which very considerable periosteal deposition can be demonstrated and used as a basis for diagnosis. In far advanced cases all other symptoms, especially pain may be absent but the roentgenological characters are quite definite.

There is a presumptive suspicion that pulmonary conditions are in some way related to the disease. The evidence, however, is not quite conclusive. It is suggested that closer roentgenological examinations be made of chronic pulmonary cases in order to see to what extent the tubular bones are involved.

Reinert, Hans. The roentgenological diagnosis of the sella. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 553–574.

A review of about 170 cases examined by the author confirms the fact that the size of the sella turcica varies within wide limits even in apparently normal cases. Very small sellas appear to occur quite frequently, usually of course in cases of infantilism and in cases of suspected dystrophia adiposogenitalis and of hypothyroidism. More or less detailed descriptions are given of 32 cases of conditions including endocrine disturbance, tumor of the hypophysis, brain tumor and syphilis. In these cases the roentgenological changes in the bony part of the hypophysis are discussed and interpreted.

From the standpoint of technique, it is important to obtain good roentgenograms in order to have a reliable diagnosis. Attention is directed to the rather frequent occurrence of a lime-poor dorsum which may be easily overlooked and lead to erroneous diagnoses. Two lateral roentgenograms, one from the right and one from the left, should always be taken. In interpreting the roentgenograms in doubtful cases, the following speak against the diagnosis of tumor of the hypophysis: (*a*) bilateral choked disc which can occur only with extensive destructions, since the diaphragma sellae separates the hypophysis from the rest of the brain; (*b*) undisturbed sexual function (in women continuance of menstruation). Facts which favor the diagnosis of tumor of the hypophysis are: (*a*) a distinct acromegalic symptom-complex; (*b*) bitemporal hemianopsia without indications of increased intracranial pressure; (*c*) symptoms of endocrine dysfunction, but only when they all point unmistakably to the hypophysis.

As a result of the observations reported, it is concluded that interpretations based on the exact size of the sella are of doubtful value, to say the least. Tumors of the hypophysis appear to show typical roentgen characteristics. Extra- and intrasellar tumors of the hypophysis can be distinguished roentgenologically from one another only very rarely. Symptoms of general intracranial pressure may show roentgenologically typical changes in the sella. Between the typical sellar roentgenogram in tumor of the hypophysis and in the case of general intracranial pressure there are to be found all intermediate stages. Especially when there is considerable change in the bony portion of the sella turcica, a definite conclusion is usually not possible as to whether there is a direct or indirect involvement of the sella.

ROCKEY, EUGENE W. Value of radiographic contrast solutions in the study of brain abscess. *Ann. Surg.*, 1927, lxxxvi, 22–30.

Brain abscess cases present many problems in treatment, not the least of which is the postoperative course after the original drainage has been instituted. A knowledge of the size, shape and accurate location of the abscess cavity is of decided value. The only practical method by which this knowledge can be acquired is by roentgenographic study after the injection of the cavity with contrast solution.

The author regards the use of lipiodol in such cases as being somewhat hazardous. On the other hand, a solution of sodium iodide is considered safer because of its solubility and ready absorption. The sodium iodide furnishes an excellent contrast medium and if injected without undue pressure in a cavity does not cause irritation. This does not refer to the thecal cavity.

A report is given of a case occurring in a man fifty-nine years old. When three years of age he sustained a compound fracture of the skull in the left parietal region. Since then the scalp had always been tightly adherent to the skull in this region. Ten years ago the scalp had so thinned that a small point of bone projected through the skin. The projecting bone was chiselled off and a skin graft applied. Projecting points of bone were also removed six and five years ago. In October, 1925, a slightly raised-edged ulcer developed in the left posterior parietal region of the scalp. This was diagnosed as an epithelioma and received one application of radium in November, 1925. The healing was not complete until August, 1926. In September, 1926, the area treated with radium became black and necrotic. The necrotic area came off the latter part of September, 1926; the patient suffered intense headache and felt sick. The scalp for an inch in all directions was red and swollen, evidently acutely inflamed. The abscess was opened and drained pus freely. From this point on the patient lost consciousness and became rapidly worse and it was decided that there must be a deep brain abscess. This abscess was punctured. After one week of drainage it was decided to make a study of the abscess cavity. A 20 per cent aqueous solution of sodium iodide was injected, 12 c.c. entering the cavity. The information thus obtained was of great value in revealing the location, size and shape of the abscess cavity and the progress of healing. The patient died three months later and autopsy disclosed a meningitis which had evidently involved the left parietal region for some days and then became generalized, thus causing death. Sections through the brain showed that the abscess cavities were well drained and that there had been no great destruction of brain tissue. Microscopic sections showed distinct organization and repair with a thin abscess cavity wall.

RÖDELIUS, E., and KAUTZ, F. Hypernephroma metastasis in the spinal column resembling a tuberculous spondylitis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 461–467.

A report is presented of a case occurring in a sixty year old man who was treated for nearly two years for multiple tuberculous caries of the spine. There was almost complete destruction of the body and arches of the third, fourth, and fifth lumbar vertebrae. The case was of interest not so much from the fact that the

metastasis was the sole clinical symptom as from the fact that the entire course of the disease both clinically and roentgenologically so closely resembled tuberculous spondylitis. The complete breakdown of the affected vertebrae was prevented by the formation of a massive solid tumor almost the size of a child's head. The case came to autopsy after two years of treatment, and the pathologist was surprised to discover a hypernephroma of the left kidney. The spinal column from the eleventh thoracic vertebra down, together with the pelvis, was removed and disclosed very extensive osteoclastic vertebral metastases.

Rusconi, M. A case of parasternal diaphragmatic hernia. *Radiol. med.*, Dec., 1927, xiv, 1116–1123.

The author first discusses the definitions of hernia and eventration of the diaphragm and says that they may even be considered identical from the point of view both of pathological anatomy and clinical manifestations if the hernia has a very large ring. The following gradations exist: (1) true hernia with a small ring; (2) atony of the diaphragm; (3) aplasia of the muscle fibers of the diaphragm; (4) more or less complete absence of the folds of the diaphragm. The most interesting clinical point is differential diagnosis between hernia with a small ring and eventration or even hernia with a large ring. In the latter case, the differential diagnosis is sometimes impossible, if there is a hernial sac. Generally there is a line arched transversely and anteroposteriorly which occupies one whole half of the thorax and may represent in true hernia the hernial sac, in false hernia and congenital absence of the diaphragm the wall of the herniated viscus and the lower boundary of the lung, and in eventration the relaxed and atrophied diaphragm.

The author denies that the phenomenon of paradoxical respiration or even that pneumoperitoneum has any symptomatic value. There are cases however in which the clinical diagnosis can be made with maximum probability, that is, when the hernia is limited and very visible and the sac, also well defined, does not permit of confusion with an eventrated diaphragm, and particularly if its site is one of those preferred by true congenital hernias. The author saw such a case. It was a case of parasternal diaphragmatic hernia in which the herniated viscus was a part of the transverse colon through a hole which was brought about by the muscle fibers of the diaphragm itself not being inserted into the anterior wall of the thorax. As there was no history of trauma it must have been congenital. There were no clinical symptoms.

Santozky, M. Roentgen diagnosis of hemangiomas. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 520–522.

Reports are given of 3 cases which were readily diagnosed roentgenographically. In each case the shadows of the hemangiomas contained denser shadows of phleboliths such as those described by Haenisch in 1925. These phleboliths were found scattered throughout the soft tissue portions as round dense structures varying from a flaxseed to a pinhead in size. In one case the larger of the phleboliths showed definite stratification. In 2 of the cases the identity of these shadows was confirmed by operation.

The presence of phleboliths in hemangiomas does not appear to be uncommon. They are easily recognized roentgenographically and may be useful in cases of doubtful diagnosis as, for instance, in deep-lying structures and in cases in which an external examination is not readily performed.

Schmidt, Walter. Roentgen diagnosis of calcified brain tumors. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 476–480.

A report is presented of a case occurring in a woman aged thirty-two, who had a completely calcified psammous endothelioma which presented several unusual points of interest. The roentgenogram showed a large, sharply outlined, continuous shadow of great density in the right hemisphere, corresponding to the extent of the tumor. As a result, very accurate topic diagnosis was possible from study of the roentgenogram alone. Moreover, the roentgenologic technique sufficed for the diagnosis of the nature of the tumor without a pathological examination of the specimen. A successful radical operation was performed and the extirpated tumor on examination confirmed the diagnosis. This tumor was about the size of a goose egg, grayish yellow in color, with a nodulated surface. In the roentgenogram the intensity of calcification decreased from the frontal to the occipital pole of the tumor. At the posterior end there was a small cap-shaped zone only slightly calcified. On section, the tumor showed a coarse granular structure with imbedded calcified masses of grayish yellow color.

Stein, Irving F., and Arens, Robert A. Iodized oil and pneumoperitoneum in gynecology. *Radiology*, June, 1927, viii, 494–501.

"The transuterine insufflation of $CO_2$ is

recognized as a safe and useful procedure in gynecologic diagnosis. Diagnostic pneumoperitoneum stands as one of the most vivid and useful methods of projecting pelvic pathology on the roentgen film. Iodized oil is of value in depicting the uterine and tubal lumina. Its chief value lies in locating the site of tubal obstruction. The information it yields concerning uterine pathology is often incomplete because the latter alters the organ contour more than its lumen. Iodized oil instillation is practically useless in diagnosis of ovarian pathology. Iodized oil and pneumoperitoneum combined yields the maximum information regarding the pelvic organs short of intraperitoneal exploration, and is indicated in a carefully selected group of cases."

TANDOJA, P. Cholecystography by the oral method. *Radiol. med.*, Feb., 1928, xv, 81–115.

The author describes in detail the technique of cholecystography after administration of tetraiodophenolphthalein by mouth, and emphasizes the importance of this method combined with an opaque meal for showing the direct and indirect, functional and morphological symptoms of disease of the gall-bladder and digestive tract and their relations to each other. He finds that these symptoms can be grouped in such a way as to be of great value in diagnosis. He describes the form, size and site of the normal gall-bladder with the patient standing and lying down, its relation to the movements of respiration, etc., in cholecystography alone or associated with the administration of drugs, food, mineral waters and Einhorn's sound. He then shows the roentgen picture of the relations existing between the shadow of the gall-bladder and that of the pylorus and duodenum and hepatic flexure under different conditions. He emphasizes the importance of cholecystography in pathological cases and describes the signs of adhesion between these different structures.

He describes the picture of the gall-bladder in gallstones and chronic cholecystitis, pointing out the sources of error that may be encountered by the roentgenologist inexperienced with the method. He describes the roentgen pictures of atony, ptosis and stasis of the gall-bladder. The article is profusely illustrated with roentgenograms of the different conditions discussed.

TROELL, ABRAHAM, and HOLMSTRÖM, P. The importance of röntgen examinations in the diagnosis of fractures of the skull. *Ann. Surg.*, 1927, lxxxvi, 502–504.

Clinical experience shows that injuries to the head not clinically diagnosed as fractures but regarded merely as a contusion of the head complicated by concussion may give rise to prolonged and troublesome sequelae. It is the authors' impression that many, perhaps most, of these persistent posttraumatic complaints are due to the fact that the injury from the outset was anatomically of a much more serious nature than the usual clinical examination suggested. This view was verified by roentgenological examination which showed that even in cases without otherwise evident symptoms for suspecting fracture of the skull, the latter nevertheless did occur in head injuries much more often than can be established by purely clinical methods.

This conclusion is based upon a summary of serious head injuries (excepting gun-shot and similar injuries) for the period April 1, 1922, to December 1, 1926, admitted to the surgical department of the Serafimerlasarett, Stockholm. There was a total of 175 cases of which 109 were examined roentgenologically. The results are shown in the table below.

| | Purely Clinical Diagnosis | Roentgen Examination | | |
|---|---|---|---|---|
| | | Positive | Negative or Uncertain | Not Done |
| | Cases | Cases | Cases | Cases |
| Severe head contusion with or without scalp wound | 14 | 5 | 9 | .. |
| Cerebral concussion | 118 | 11 | 45 | 62 |
| Cerebral compression | 23 | 17 | 4 | 2 |
| Cerebral contusion | 7 | 1 | 4 | 2 |
| Fracture base of skull | 7 | 6 | 1 | .. |
| Fracture theca cranii | 6 | 6 | .. | .. |

VOGL, ALFRED. Traumatic pneumatocephalus. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 587–592.

A report is given of a case of traumatic pneumatocephalus occurring in a young man aged twenty-six as a result of an automobile accident. There developed a general internal pneumatocephalus as a result of communication of a pneumatic cyst in the left frontal brain with the left lateral ventricle on the one hand and with the frontal sinus and the nose on the other. The patient succumbed to a meningitis and the roentgenographic diagnosis was confirmed at autopsy.

A review of this and other cases reported in the literature suggests that traumatic pneumatocephalus in fractures of the base of the skull would not be such an extremely rare condition if successive roentgenograms were

taken in those cases in which there is opening of the pneumatic cells of the skull and in which there occur symptoms of intracranial pressure. The clinical finding of a tympanitic sound on percussion of the vicinity of the fracture should suggest such an occurrence. Such a sound indicates a local accumulation of air either extra- or intracerebral, whereas air accumulation in the deep ventricles does not give rise to tympany. The prognosis in such cases in which no virulent infection enters the cranial cavity, is usually favorable, the resorption of air occurring spontaneously. The only indications for surgical intervention appear when threatening increases in intracranial pressure appear or when there is present a cranial fistula with sterile cerebrospinal fluid.

VOORSANGER, WILLIAM C., and FIRESTONE, FRED. Undiagnosed cough. *J. Am. M. Ass.*, Oct. 1, 1927, lxxxix, 1137–1140.

Careful physical and roentgen-ray examinations and sputum culture are recommended in all patients with cough persisting more than six weeks. Beginning bronchitides should be studied as carefully as beginning tuberculosis. Such measures as injection of iodized oil and diagnostic pneumothorax followed by roentgenograms are of inestimable value in differentiating various pulmonary non-tuberculous conditions.

Infectious bronchitis and asthma must be recognized as a disease since it was found in 37 per cent of a group of 200 patients; 38 per cent of the cases showed peribronchial and hilum thickening, enlarged bronchial root glands and even fibrotic infiltrations in the lungs. This group remains undiagnosed and must be given further study. Patients in this group must be considered as future subjects for either tuberculosis or bronchiectasis.

WASSON, W. WALTER. A developmental study of the nasal accessory sinuses. *Radiology*, May, 1927, viii, 398–408.

Contrary to the teachings of to-day, it is shown that young infants can and do have infection of the paranasal sinuses. The results of such infections can be clearly shown by roentgenograms, and many excellent illustrations are submitted. The roentgenogram is quite accurate in its portrayal of the anatomy and pathology of these infections and checks very closely with physical examinations. Infection of the paranasal sinuses in infants affects very probably the susceptibility of the adult to sinus infections and other diseases of the body. The medical profession should be educated to expect such early infections and take the proper steps to overcome them; they must first be taught that paranasal sinus infections are not uncommon in young infants.

WASSON, W. WALTER. Thymic stridor. *J. Am. M. Ass.*, Sept. 24, 1927, lxxxix, 1025–1028.

A discussion is given of respiratory stridor occurring in infants from one month to one year of age, the stridor varying in character and usually attributed to the thymus. The term stridor is applied in a general way to any noise apparently coming from the trachea. Roentgenographic study of a number of infants has disclosed an impressive frequency of evidence of infection of the bronchi and even the lungs. Frequently at one or two months of age or even earlier the infection makes its appearance and may be traced roentgenographically to a definite pathologic condition at two, three or four years of age. The paranasal sinuses have been found to be associated frequently with such infection and the incidence of sinusitis increases rapidly after the first few weeks of life. Eight cases are briefly cited showing that the thymus frequently increases in size from birth to one year of age and that there is often infection of the sinuses and bronchial systems without many symptoms pointing to such infections. There may be a mere coincidence of infection in the respiratory tract with respiratory stridor and with a large thymus. It is quite likely that some of these cases were caused by mucus in the trachea and bronchi without definite infection and were therefore relieved by treatment directed toward the relief of this mucus or by natural development of the child and his reflexes.

There seems to be no doubt that roentgen-ray therapy applied to the region of the thymus does relieve respiratory stridor or thymic stridor, but this does not necessarily prove that the stridor is due to the thymus. Some of the results of radiation therapy occur almost too rapidly, even before reduction in size of the thymus could take place, and these cases are assumed to be improved by change in the secretion of the thymus. One might just as well reason that such benefit is due to the effect of the radiation on the mucous membrane. The author has observed that stridor does not increase with increase in the size of the thymus. No objection is raised to radiation therapy in this class of cases but the author questions whether it is fair to assume that a case of stridor is due entirely to the thymus based on roentgenographic evidence of a large thymus or even of a small thymus and thus deprive the infant of further examination directed toward the sinuses or the lungs. The respiratory tract

is often involved in this class of cases and other methods of treatment besides radiation therapy give equally good results.

WHITLOCK, S. B. Skull pathology revealed by the roentgen ray. *Radiology*, Aug., 1927, ix, 153–161.

The use of the roentgenogram in showing pathologic conditions in the skull which might otherwise have been overlooked is brought out by the author and illustrated with roentgenograms of representative diseases. The pathologic processes recognizable by the roentgen examination are neoplasms, inflammatory and infectious processes and dystrophies. Carcinomas, sarcomas, multiple myelomas, osteoma, etc., can be recognized readily. Brain tumors are not included, yet at times even these can be observed by routine examinations of the skull. Syphilis, tuberculous osteitis, acute osteomyelitis, Paget's disease, etc., leave pathologic changes in the skull clearly brought out by the roentgenogram. Illustrations of normal skulls and those affected by these diseases are submitted.

## ROENTGEN AND RADIUM THERAPY

CARP, LOUIS. Treament of carbuncles. *Ann. Surg.*, 1927, lxxxvi, 702–706.

A comparison is made of the following four different methods of treating carbuncles: by roentgen ray, by surgery, by conservative therapy and by autogenous blood circuminjection. There is difficulty in evaluating the various methods of treatment because each case is a problem in itself and surgical judgment should be a guide as to therapeutic preference.

The present report is based on 153 cases of non-diabetic and diabetic carbuncles admitted to the Presbyterian Hospital, New York, in the past ten years. In the non-diabetic group 22 cases were treated with roentgen rays, 56 by surgery, 33 by conservative therapy and 12 cases by blood circuminjection. In the diabetic group 6 cases were treated by roentgen rays, 23 by surgery and one conservatively. The roentgen treatment was applied by the following technique: 8.5 in. spark gap, 3 mm. Al filter, dose $\frac{2}{3}$ to $\frac{3}{4}$ of a skin erythema unit. All of the cases received accessory therapy in the form of poultices and various other antiseptic dressings. The diabetic cases also received insulin therapy.

The following conclusions are drawn from this series. In large carbuncles, diabetic and non-diabetic, the treatment of choice is radical surgery. In small superficial carbuncles and in some large carbuncles, including those of the face, roentgen therapy as an aid to conservative therapy (poultices, carbolization, etc.) has given good results. If, however, improvement does not occur in three or four days other measures are indicated. In diabetic carbuncles prompt establishment of free drainage is essential in order to prevent spread of infection. Roentgen therapy without surgery is contraindicated. Circuminjection of autogenous blood may be used in selected cases and it is a valuable adjunct in accessible spreading infections treated by any other method. There has been no proof in the clinical cases analyzed in this series that roentgen therapy alone effected a cure.

COLEY, WILLIAM B. Prognosis and treatment of giant-cell sarcoma. *Ann. Surg.*, 1927, lxxxvi, 641–665.

A report is given of a careful follow-up of 50 cases reported in 1923, together with 19 additional cases since observed. The entire series should furnish sufficient data from which to form definite conclusions on two important points, namely: (1) whether giant cell sarcoma is always a benign lesion, and (2) what is the best method of treating these cases.

The conclusions of this study are summarized as follows. Giant cell sarcoma or "giant cell tumor" as it is designated by most pathologists today, while in the great majority of cases a benign or at least only locally malignant lesion, should still be classed as a sarcoma since in certain cases it has shown all the clinical features of a malignant bone tumor causing death by metastases. In the majority of cases the clinical and roentgen-ray evidence will permit a diagnosis of benign giant cell sarcoma; but in about 20 per cent of the cases it is impossible to differentiate the benign from the malignant type without the aid of a microscopic examination. It is not always possible to differentiate the malignant from the benign cases from the clinical, roentgen-ray and microscopic data.

It is possible to cure the majority of benign giant cell sarcomas by curettage and carbolic acid or zinc chloride. If the disease recurs, repeated curettage may be necessary. If the destruction of bone is so great that a pathologic fracture develops rendering the limb useless, amputation may be necessary; but not always so, as in a number of cases firm union has later taken place and the patients have remained permanently cured.

Largely through the splendid work of Dr. Herendeen it is now possible to state definitely that giant cell sarcoma can be cured by

irradiation. Whether a larger proportion can be cured by this method than by curettage one is at present unable to determine for lack of a sufficient number of cases treated by radiation and followed to end-results. The time required to effect a cure by radiation therapy is considerably longer than that required by operative treatment or by toxins, with or without curettage and hence the period of disability is prolonged. The chief disadvantage of radiation treatment as a routine primary method for giant cell sarcoma lies in the fact that in a considerable number of cases the diagnosis of benign giant cell sarcoma cannot be made from the clinical and roentgen-ray data alone.

It is possible to cure benign giant cell sarcoma and even far advanced borderline cases (giant and spindle cell sarcoma) by injections of mixed toxins of erysipelas and *Bacillus prodigiosus* without other treatment. Furthermore, it is possible to cure these cases by a combination of toxins and irradiation or toxins and curettage. It is possible to cure these cases most rapidly and most certainly by surgery (curettage) followed by toxins. This method entails a much shorter period of disability and is not associated with greater risk; and in the author's opinion it is at present the method of choice.

In the present series the cases are divided into two groups as follows: (1) cases treated primarily with roentgen rays or radium without previous biopsy, 13 cases; (2) cases treated by radiation after biopsy or curettage, 15 cases; (3) cases treated by surgery alone, 16 cases; (4) cases treated by toxins alone or toxins and surgery, 16 cases; (5) cases treated with toxins and radium or toxins and roentgen rays and radium, 9 cases. The results in each case are briefly cited.

Del Buono, Pietro. Roentgen therapy of skin cancers with soft and oversoft rays. *Radiol. med.*, Feb., 1928, xv, 115–128.

The author describes and illustrates a number of superficial skin cancers in which he has had permanent cure by the use of soft rays (30–35 kv.). He says that these and the oversoft rays of 9–12 kv. exercise a biological action on the skin which is a direct function of the amount of rays used and that if the dose absorbed per unit of value remains the same, the biological action of the rays is effective whatever the quality of the rays or the method used. With higher tensions up to 80–90 kv. the coefficient of penetration of the bundle of rays increases to 4–6 cm. beneath the skin. In treating ulcerated skin tumors it is necessary to consider not only their surface extent but also the depth of the lesion, as rays of a certain wave length cannot have a destructive action on cancer tissue at a depth lower than they are capable of penetrating.

Dean, Archie L. Ulceration of the urinary bladder as a late effect of radium applications to uterus. *J. Am. M. Ass.*, Oct. 1, 1927, lxxxix, 1121–1124.

The application of radium to the uterus in doses greater than 3,500 mg-hr. may be followed by extensive destruction of the bladder mucous membrane. So much ulceration may occur as to entail a fatal hemorrhage. When irradiation of the uterus by radium was followed by an ulcerating bladder lesion, there was an interval of at least a year between the time of the irradiation and the onset of bladder symptoms. In these cases the age of the patient, the history of the present illness, the symptomatology and the cystoscopic examination strongly point to the presence of a bladder carcinoma.

Before any treatment is begun a biopsy always should be performed on ulcerating lesions of the bladder. The nature of the ulcers of the bladder base secondary to irradiation of the uterus with radium is an obliterative endarteritis. Since the condition is one of central necrosis due to an insufficient blood supply it seems reasonable to suppose that treatment by destructive agents such as fulguration, the actual cautery, diathermy or further irradiation would be followed probably by the formation of a vesicovaginal fistula. After experimenting with many remedies, the author believes that the most effective treatment has consisted of an alkaline hyoscyamus mixture administered by mouth in conjunction with mercurochrome instilled into the bladder. With the use of these agents the subjective symptoms have been relieved promptly but complete healing requires several months. Three cases are briefly cited.

Johnston, Zoe Allison. Treatment of nevi with radium. *Radiology*, April, 1927, viii, 292–299.

Five case reports are given in which radium was successfully used in removing nevi in young children. Photographs are submitted to show the completeness of the removal. The writer is convinced that the most thorough removal and the best cosmetic results are obtained in the treatment of nevi by means of radium. In the first case the nevus was over

the eyelid and almost closed the eye; the only treatment necessary to effect cure was the application of two needles of radium each containing 10 mg., each being inserted for one hour and fifteen minutes. In the second case reported, the angioma of the upper eyelid grew until it involved the nostril as well as two-thirds of the upper lid. Surgical removal was resorted to at the age of three months; a scar was left and on both sides red discoloration with extensive involvement underneath. The lid felt spongy and was almost twice the size of the ordinary lid. Six applications of radium were used; the first treatments were heavily filtered, using 1 mm. brass and 1 mm. rubber, followed by more superficial applications in which only 1 mm. of rubber was used. The third case suffered from an angioma involving the entire nose with the exception of a small part of the right side, and a small area on the right shoulder. The treatments used were as follows: first, three needles, each containing 3 mg. of radium, were inserted through the nose for forty-five minutes; five months later, eight 10 mg. needles were inserted through the lesion on the shoulder for one hour and thirty minutes; ten months later, one part of the nose still remained spongy, and one 10 mg. needle was inserted for one hour. The fourth case was treated for a hairy pigmented mark which was not vascular. Two applications of beta rays of radium two months apart were sufficient to cause the mark to become smaller and flatter and destroy the hairs. The remainder was removed by means of the electric spark. The fifth case had a deforming angioma involving the tissues of the upper part of the nose and areas above and below the left eye, with several small areas on the forehead. Nine applications of radium were given. To treat the deeper portions two 25 mg. tubes of radium were used, these filtered through 1 mm. brass and 1 mm. rubber at a distance of 2 cm. Around the edges and parts that were not so thick the radium was filtered through rubber only. A few telangiectatic lines showed in the center of the area, but these will be removed when the child is a little older, by means of the electric needle. These cases show the quick and ready means at hand in radium for treating nevi in children, and the photographs show how completely the cures have been effected.

KEENE, FLOYD E., PANCOAST, HENRY K., and PENDERGRASS, EUGENE P. Value of irradiation in treatment of inoperable carcinoma of the ovary. *J. Am. M. Ass.*, Sept. 24, 1927, lxxxix, 1053–1055.

A report is given based on an analysis of 24 cases referred to the University of Pennsylvania Hospital for treatment. There were two groups of cases; the first comprising 6 cases includes those with widespread peritoneal metastases in whom only an exploratory operation was performed. Five died within eight months after irradiation, one is living five months after irradiation but is failing rapidly. Ascites was present in 5; and the treatment left 2 uninfluenced and in one a diminution was noted. In only one of 3 cases with abdominal pain was the latter materially influenced.

A second group, comprising 18 cases, had a primary growth excised followed by irradiation. Of these 7 are living. The 11 who died survived two and a half months to forty-eight months after irradiation. The 7 cases surviving are living from seven months to fifty-seven months after irradiation.

These statistics seem to show that the progress of an extensive growth can be retarded by irradiation and it therefore seems wise from the standpoint of treatment to remove as much of the large primary growth as possible by operation in order to have that much less carcinoma to deal with and to produce extension. This is somewhat analogous to palliative breast amputations which are frequently advisable. The present dosage factors employed by the authors for each port of entry are: 200 kv., distance 50 cm., filter 0.5 mm. Cu plus 2 mm. Al, 4 ma., time 75 to 100 minutes, size of fields 14 × 17 to 17 × 17 cm. Radiation sickness has always been a difficult condition to control in treating ovarian carcinoma; when the abdomen is filled with cancer and fluid it has been found that short daily applications by a fractional dose method are less likely to produce this undesirable effect. It is believed that this method is more efficacious than a massive dose administration. Pfahler's recently described "saturation method" may be used to advantage but great care is essential in its use. It should be borne in mind that many of the author's cases were treated by the old low voltage method of many years ago.